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MINISTRY OF AGRICULTURE

Annual Report

of the

Water Development and Irrigation Division

1962

1964
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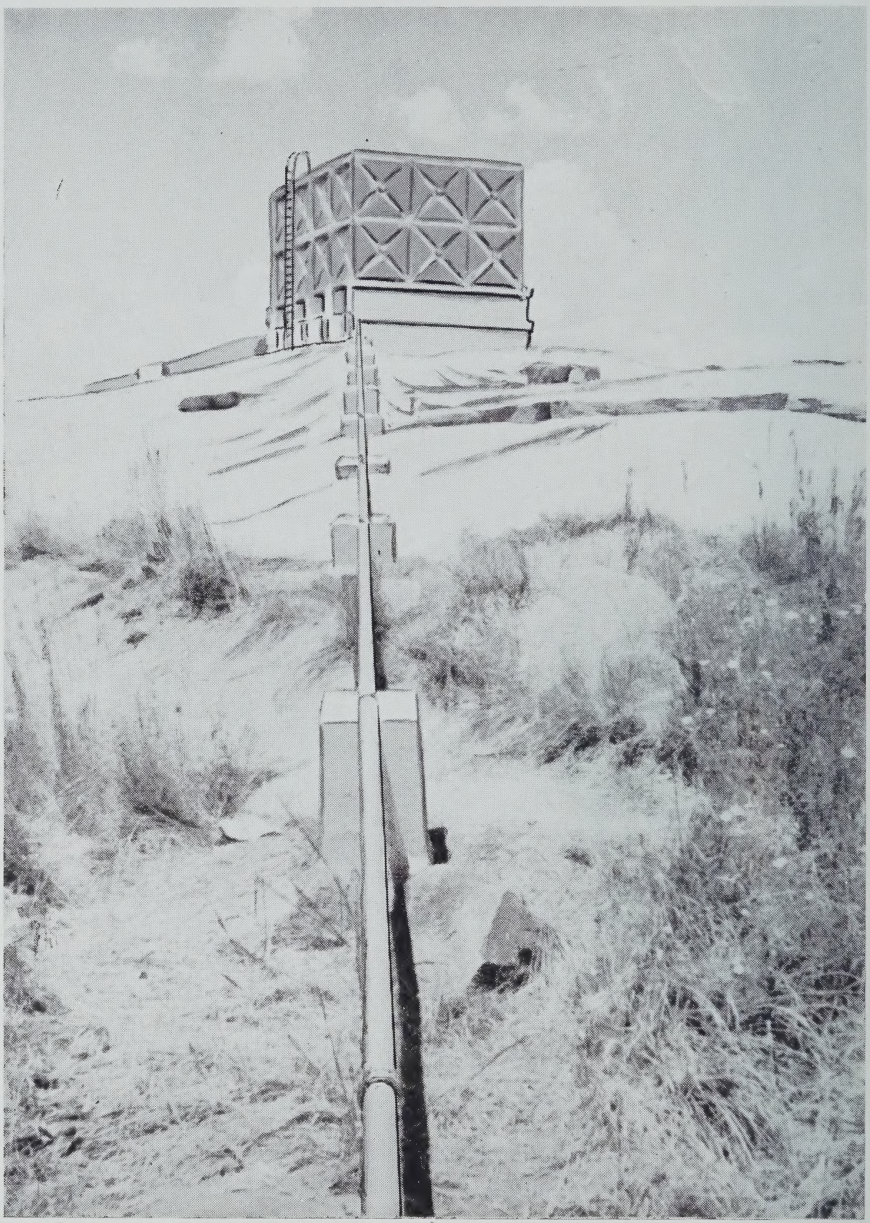


MAGU WATER SUPPLY
9,600-gallon storage tank and delivery main to village

TANGANYIKA

ANNUAL REPORT OF THE WATER DEVELOPMENT AND IRRIGATION DIVISION, 1962

I.—INTRODUCTION

The Water Development and Irrigation Division of the Ministry of Agriculture is responsible for providing rural domestic water for humans and animals, for the conservation of water to improve river flow and prevent floods, for the execution of irrigation schemes, for hydrological investigations and for long-term planning of major water development works. Throughout the country there is an increasing pressure for general development, and as the demand grows for higher living standards, increased agricultural production and the better utilization of grazing land, so there is a corresponding need for new and improved water supplies for domestic use, irrigation and stock. It is the function of the Water Development and Irrigation Division to supply this need.

2. The Ministry of Agriculture, of which the W.D. & I.D. forms one Division, underwent a major re-organization in July, 1962, as a result of which the number of Divisions was increased and now includes Administration, Agricultural Extension, W.D. & I.D., Development, Veterinary, Research, and Training. This re-organization brought little change to the functions and responsibilities of the W.D. & I.D., except that the Technical Assistants' Training Course at Ubungo passed over to the Training Division.

3. The process of handing over responsibility for workshop maintenance and overhaul of W.D. & I.D. mechanical plant and transport to the Electrical and Mechanical Division of the Ministry of Communications, Power and Works is nearly complete and now only the Dodoma depot in the Central Region remains to be transferred. In order to handle directly the fabrication of minor items required in connection with the construction programme; all regional depots of the W.D. & I.D. continue to maintain small workshops of their own.

4. Although the overall staff position has been maintained without marked deterioration, there are some weaknesses which are a serious handicap to the work of the Division, at a time when the importance of the Project Planning and Research Station at Ubungo is increasing, it is especially unfortunate that the Division has lost the services of several of its most experienced Technical Assistants engaged on Hydrology, and the situation has been aggravated by the continued vacancy of the post of Chief Designs and Research Engineer. Also a source of concern is the continued lack of success in recruiting Civil Engineers, both locally and from overseas, and at the present time there are some 10 vacancies with little prospect of early filling. On the credit side, a Senior Hydrologist has been recruited, and strenuous efforts are being made to accelerate the technical training programme.

5. The year has again been characterized by widespread floods with famine conditions persisting in certain areas, particularly the Central Region, and parts of the Northern Region. These unfavourable conditions have combined to diminish the financial resources of some Local Government Authorities, and this state of affairs has been partly responsible for the decreased utilization of the earthmoving teams. On the other hand, widespread support for self-help or Nation-Building Schemes has resulted in many small water development works being undertaken throughout the country, the overall effect of which on the territory's economy is very important. In the better watered areas, there is growing evidence of the increasing interest of local farmers in village irrigation schemes, and the progress recorded in this direction during the year is encouraging—it is anticipated that this class of work will play an increasingly important role in the annual W.D. &. I.D. programmes of the future.

6. There was an unfortunate general slowing-down in works construction which affected all Regions during the most favourable dry time of the year due to financial considerations, and this is a further reason for the drop in capital expenditure from £902,086 to £652,534: weather conditions were yet another important contributory factor.

7. The programme of water control works carried out during the year has been an important one and includes such items as river training, improvements to flood control dams and irrigation schemes, also reconstruction of the spillway on Igombe dam which suffered damage during the unprecedented floods of 1961/62. As the tempo of development throughout the country increases, so the demand for water control works will expand in order that vital communications, valuable farm land and buildings can be protected from floods.

8. The total expenditure for 1962 shows a considerable decrease on the previous year and some reasons for this have already been mentioned above; more information on this subject will be found in the appropriate chapter of this report. A total of 21 piped water supplies were completed as compared with 44 in 1961, and as regards earth dams and charcos 9 were completed as against 13 the previous year. The programme of water boring by percussion drill proceeded steadily, as a result of which 17 new boreholes were completed compared with 38 the year before. Expenditure on water supplies for Rural Local Authorities amounted to £131,750 which is little more than half the figure for the previous year, but expenditure for water control works increased to £109,055. A new item for Major Projects (Surveys and Investigations) accounted for £70,059 as against "nil" expenditure in 1961, and there was an increase to £38,895 for water supplies for other government departments.

9. The growing importance of hydrological investigations in connection with future plans for development of the country's water resources continues to be recognized, and following the appointment of a Senior Hydrologist steps have been taken to review the network of river gauging stations and other installations and to bring them up to a higher standard. As already mentioned, the Hydrological Section has lost a number of its more experienced field officers and one of the Division's main endeavours must be to replace these as soon as possible and to continue with a steady build-up in staff and facilities. The publication of the Hydrological Year Book has been held up as a result of typing and reproduction delays, but the work is now virtually complete. This first volume, which covers the period 1950-1959, includes records from 244 stations of different classifications, representing a great mass of technical data. It is hoped that subsequent issues will be published annually and will cover fully all aspects of the hydrological work carried out during the year.

10. The Division has continued to receive valued assistance from the team of F.A.O. experts, whose work has been concentrated during the year mainly in the Wami River Basin and the Coastal Belt of the Eastern Region; in addition, however, these experts have prepared preliminary reports on a number of smaller projects, such as the Lukuledi River, some of which await formal publication and issue from F.A.O. Headquarters in Rome. More detailed investigation and surveys of selected areas and projects within the Ruvu and Rufiji River Basins have proceeded smoothly with the assistance of technical teams from France and Switzerland: as a result detailed proposals will shortly be available for several pilot schemes, each of several hundred acres and also outline proposals for flood control measures which would make a major contribution to the regulation of the Ruvu River. The successful establishment of a 50-acre pilot pumped irrigation scheme on Lake Victoria, which was constructed by this Division with Israeli technical aid is especially significant.

11. The date for the implementation of an important project designed to develop the water resources of the Pangani River has been brought appreciably nearer by the receipt of the Draft Report of the Engineering Consultants, Sir William Halcrow & Partners. This Draft Report, to be followed shortly by the Final Report, follows the carrying out of an extensive programme of surveys and investigations, as a result of which it should soon be possible to go ahead with hydro-electric power generation and irrigation projects of a substantial nature.

12. The year has seen encouraging progress in many branches of the work of the W.D. & I.D., but if this is to be maintained and improved on in the years ahead, urgent consideration must be given to steps designed to improve the training and recruitment of both technical and professional staff, particularly Civil Engineers, for whom there is a worldwide demand in excess of supply.

II.—ORGANIZATION

13. The Headquarters of the W.D. & I.D., are in Dar es Salaam and there is a branch office in each of the nine regions. In addition there are five sub-offices operational in Moshi, Singida, Same, Korogwe and Iringa. The Engineering Geologist's headquarters are in Dodoma, and the Project Planning Station, including the Hydrological Section and the Technical Assistants Training School is at Ubungo on the outskirts of Dar es Salaam.

14. The Water Development and Irrigation Division has continued under the Ministry of Agriculture which has however been reconstituted during the year so that there are now seven Divisions in the Ministry, namely Administrative, Agricultural Extension, Water Development and Irrigation including the Water Office, Veterinary, Research, Development and Training. The Co-operative Division was transferred to a new Ministry during the year. The Training School at Ubungo, along with all other training centres in the Ministry, was put under the control of the new Training Division, which is now responsible for all training.

15. The transfer of the responsibility for the maintenance and overhaul of mobile plant and equipment to the Electrical and Mechanical Division of the Ministry of Communications, Power and Works continued, and at the end of the year the hand-over was complete in eight of the nine regions, leaving only the large W.D. & I.D. workshop in Dodoma to be transferred. Throughout the country the W.D. & I.D. remained in charge of field maintenance of its own plant and retained the use of its own workshops for its constructional activities.

16. Ministry of Agriculture Regional Accounts Units were set up during the year in nearly all regions and these took over all accounting work from the W.D. & I.D., and other Divisions of the Ministry. This centralization relieved W.D. & I.D. of a large amount of office work.

17. The final handing over of stores to the Stores Division of the Ministry of Communications, Power and Works, was completed during the year by the transfer of the large holdings in the W.D. & I.D. store at Dodoma to this organization.

18. The increased divisional activity in Tanga Region, and particularly in Same District, called for the extension of office and depot accommodation there, and land for a new depot in Same was acquired and a combined office/stores building constructed. With continued inactivity in water development works in Southern and parts of Northern Region the sub-depots at Masasi and Mbulu remained closed and it was also found necessary during the year to close down the Ngorongoro sub-depot for the same reason. Two dormitory blocks for the Training School at Ubungo were constructed.

19. Short-wave radio communications were extended to give cover to the difficult-of-access Rufiji Basin with encouraging results, and at the end of the year it was proposed to equip one of the drilling rigs with a radio set as an experiment.

III.—STAFF

20. Mr. I. L. Ward, who was Head of the Division from 1959 to 1962, left the country on retirement in May and was succeeded as Commissioner by Mr. S. L. Paterson, who had previously held the post as Deputy Commissioner.

21. On the 1st July the designation of the Head of the Division reverted to Director from Commissioner as previously.

22. The overall position in the professional and senior technical grades improved during 1962 with the arrival of a Senior Hydrologist, and Executive Engineer and six Technical Assistants, Grade I from the United Kingdom on first appointment, but satisfaction at this state of affairs was tempered by the fact that on the 31st December, 1962, notices of retirement or resignation were held in respect of 10 per cent of the total establishment of 80 officers in these top grades.

23. The post of Chief Designs and Research Engineer (previously Chief Planning Engineer) remained vacant throughout the year.

24. During 1962 the whole of the Mechanical Staff, from Mechanical Engineer down, were transferred from W.D. & I.D. to the E. & M. Division of the Ministry of Communications, Power and Works. Of Chief Inspectors and Inspectors (Mechanical) posts, as many vacancies as filled posts were handed over during the course of this exercise.

25. The following table shows the position of senior posts in the Division as at 31st December, 1962:—

Category	Establishment	Posts Filled	Vacancies	Vacancy Percentage
Senior (Staff Grade) Officers	8	5	3	37·5
Professional Engineers and Geologists ...	26	18	8	30·8
Senior Engineering Assistants and Engineering Assistants, Grade I ...	46	37	9	19·6

26. A number of promotions, mainly of African staff, to Technical Assistants Grade II improved the position at this level to the extent that there were only 25·7 per cent vacancies at the end of the year and the Division's strength in this grade seems likely to be maintained.

27. The post of Senior Draughtsman was filled in January, 1962, by a local appointment and the year ended with the Drawing Office staff almost at full strength.

28. Further resignations from Inspectors (Drilling) were partly offset by the recruitment of two new officers from the United Kingdom and on the 31st December there were two vacancies existing with a further one pending.

29. Clerical staff were up to full establishment almost throughout the year, but will inevitably be weakened when six of the existing Office Supervisors, Grade I and II, now under notice of retirement, leave during 1963.

30. One Tanganyikan continued his post-graduate training in Civil Engineering in the United Kingdom where he remained throughout the period under review. The hoped for Pupil Engineer recruits from graduates of the Royal College, Nairobi, were not forthcoming however and prospects of filling existing and pending vacancies in the Executive Engineer cadre from local sources remain doubtful in the foreseeable future.

31. The Fifth Ubungo Training Course for Technical Assistants Grade V was completed at Ubungo in June and thereafter the responsibility for further courses was transferred to the Training Division of the Ministry.

32. Staff from the Division represented Tanganyika at:—

(a) A meeting of the Executive Committee of the International Commission on Irrigation and Drainage held in Israel in June, 1962.

(b) Meetings with representatives of the U.A.R. and the Sudan on the use of the Nile waters held in Nairobi, and Kampala in July, 1962.

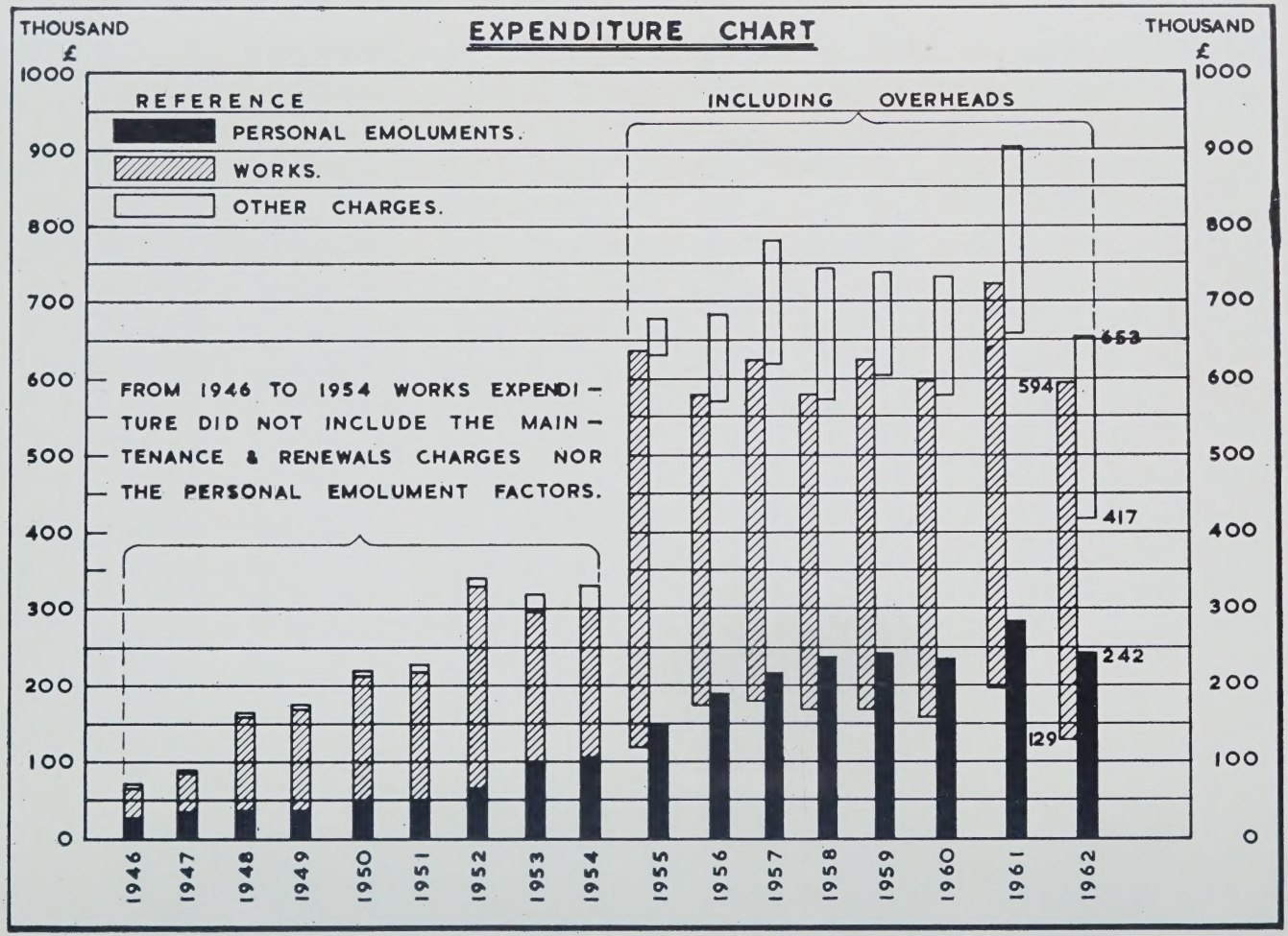
(c) An International Near-East Trade Fair at Tel Aviv in June, 1962, where Tanganyika had an exhibition stall.

IV.—FINANCE AND EXPENDITURE

33. Expenditure in the calendar year of 1962 and in the previous year is shown in the table below and is illustrated diagrammatically on the expenditure chart of the next page.

Item	Details of Expenditure	Expenditure 1961 £	Expenditure 1962 £
1.	*Recurrent:*		
	Personal Emoluments	280,907	242,121
	Other Charges	243,357	235,883
	Special Charges Expenditure	597	794
	Total Recurrent...	524,861	478,798
	Less Appropriations-in-Aid	149,787	291,484
	Net Total Recurrent ...	375,074	187,314

Item	Details of Expenditure	Expenditure 1961 £	Expenditure 1962 £
2.	*Capital:*		
	Water Supplies (Capital Equipment)... ...	55,815	67,325
	Water Supplies (Construction)	37,220	16,957
	Water Supplies (Surveys and Investigations) ...	83,030	31,184
	Major Projects (Surveys and Investigations) ...	—	70,059
	Water Supplies (Rural Local Authorities) ...	253,736	131,750
	Water Control	84,775	109,055
	Ngorongoro Compensatory Supplies... ...	5,492	—
	Water Supplies (Other Government Departments)	6,944	38,895
	Total Capital Expenditure ...	527,012	465,220
	Total Expenditure ...	902,086	652,534


EXPENDITURE CHART
THOUSAND £
THOUSAND £
1000
900
800
700
600
500
400
300
200
100
0
REFERENCE
PERSONAL EMOLUMENTS.
WORKS.
OTHER CHARGES.
INCLUDING OVERHEADS
FROM 1946 TO 1954 WORKS EXPENDI-TURE DID NOT INCLUDE THE MAIN-TENANCE & RENEWALS CHARGES NOR THE PERSONAL EMOLUMENT FACTORS.
653
594
417
242
129
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962

34. An examination of the above table, shows that expenditure in 1962, was less than in 1961 under almost all items, whereas the Appropriations-in-Aid, are almost double the figure for 1961. The following points are offered in explanation. The reduction in Personal Emoluments is due to the transfer of all the staff of the mechanical section to the E. & M. Division of Compoworks, in July, 1962, making a saving of about £15,000 and to the fact that a number of senior officers retired from the Division towards the end of 1961. The extremely severe wet season at the beginning of 1962, coupled with a four-month period from July to November when funds for construction were available only in limited amounts while awaiting the outcome of financial negotiations, was responsible for the decrease in Capital Expenditure. The increase in Appropriation-in-Aid is explained by a reassessment of Hire and Renewal charges on Works Plant and Transport; these rates were low and almost all were adjusted in an upward direction.

35. The increase in Appropriations-in-Aid (*which includes P.E.F. charges), combined with the other factors caused a reduction in net total recurrent expenditure to almost half the 1961 figure. The unusually large jump in Appropriations-in-Aid which, as stated above, was caused mainly by an upgrading of the Hire and Renewals charges on vehicles and equipment led consequently to increased Capital Expenditure, so that this is not strictly comparable with the 1961 figures. A true comparison after deducting difference in Hire and Renewals charges, shows that the construction programme in 1962 was approximately 75 per cent of the previous year.

36. Although about half of the construction year was lost due to the causes mentioned above, it was possible to proceed with surveys and the preparation of schemes. As a result once adequate funds were available, the output was at a high rate.

37. As in previous years, work for Rural Local Authorities was on the basis that the Local Authority would pay 25 per cent of the cost. In addition, on smaller jobs it is becoming more common for Local Authorities to pay the full cost of the work. This applies in particular to boreholes and borehole headworks. There is no particular rule as to when a Local Authority pays 25 per cent or 100 per cent, except that on small jobs Local Authorities are inclined to pay the full amount rather than wait to see if Government assistance is available.

38. Expenditure item under Major Projects (Surveys and Investigations) was new and of a sizeable amount, and was spent mainly on the investigation of the Pangani Basin, by Sir William Halcrow and Partners, and on work for French teams and a Swiss team, in the Ruvu Basin, and on the Lumemo River respectively.

39. *The Personal Emoluments Factor (P.E.F.) is an allowance for overhead expenses including the salaries and allowances of field staff, and is charged on all Capital Expenditure except Surveys and Investigations (Water Supplies and Major Projects). The factor is charged as a percentage on cost, and was the same as in previous years, namely: Dams 40 per cent, Gravity pipelines 30 per cent, Boreholes 100 per cent, Open wells 50 per cent and Pumped water supplies 40 per cent.

V.—MINOR SURVEYS AND EXPLORATORY WORK

40. As in previous years, the design and construction of numerous water development and irrigation works throughout the territory necessitated the carrying out of many reconnaissances, site investigations, including soil and water sampling, and topographical surveys. Every proposal for a water development scheme requires a technical examination which usually calls for topographical surveys and frequently hydrological investigations, the sinking of trial pits, tests of soil, analyses of water, etc. Very often comparative studies of several places have to be made before a firm recommendation can be put forward as regards the site of a dam, an irrigation off-take from a river or a borehole. Particularly detailed investigations are necessary before the design of engineering works to control flooding of rivers. Such activities occupy a very large proportion of the time of the technical staff, and although investigations of this nature are not always directly productive, they form an important and essential part of this Division's duties.

41. Although the minor surveys and investigations are too numerous to describe in full, mention may be made of a few which could be regarded as typical and conveying a general impression of this part of the W.D. & I.D.'s work. The proposed Madahuli pipeline, designed to bring water for domestic and livestock purposes to a wide area lying in the

triangle between the Manonga and Wembere Rivers, necessitated a location survey for the alignment of over 50 miles of piping; in addition, foundation studies and site surveys were needed for the design of an important earth dam at Mwamapuli to supplement the supply from the existing dam at Bulenya Hills: river training and flood control problems on the Morogoro River, particularly within the township boundaries, required detailed surveys of the river course extending over 1½ miles—this is a continuation of earlier work which led to the design of a gabion training wall upstream of the main road bridge: similar river training problems on the Mkundi River led to surveys of the old river channel over a distance of four miles between the recently completed gabion wall and the main road: in this case, the survey was found necessary to investigate the cause of the continued erosion of the river bed: village irrigation development in the Gonja area of Tanga Region has called for a varied programme of investigation and survey, including two dam sites, a short tunnel alignment and an irrigation development area of some 500 acres: lower down the Pangani Valley, at Mombo, planning has been proceeding in connection with a 1,000-acre irrigation scheme incorporating a regulator on the Mombo River—as in the previous case, foundation investigations and contoured surveys were carried out: the settlement of several thousand refugees in the Ngara District of the West Lake Region has posed important water supply problems, to solve which numerous topographical surveys for small hand-built dams have been executed: the Kitengule Plains ranching scheme also in the West Lake Region has posed some difficult water supply problems, which have been investigated by the sinking of trial boreholes and Banka drilling holes, in addition a survey has been carried out in connection with a possible pumped supply from the Kagera River: another ranching scheme, this time at Zoissa in the Central Region, called for a general study of ground water resources by geophysical means, in an area where conditions are not particularly favourable for borehole water supplies.

42. In addition to the foregoing, there have been the usual innumerable surveys for small dams and Nation Building schemes on a self-help basis which have kept the staff fully engaged in all Regions.

43. The Water Boring Section carried out 38 geological/geophysical surveys for borehole sites, distributed all over the nine Regions with the exception of Western, Southern and Southern Highlands: of the above, 25 were undertaken for Local Authorities, 4 for Government Departments, 8 for private clients and one exploratory survey for Divisional information. This work involved 271 depth probes to between 150 ft. and 700 ft., and 15 constant separation traverses totalling 38,170 ft. in length. Geophysical forecasts had a success rate of 73·8 per cent.

44. The diamond drilling programme suffered from the fact that the operator was absent on leave for a short period during part of the year, but extensive exploratory drilling was carried out on the sites of the proposed Jangalo Dam in Central Region and the proposed Kidunda Dam on the Ruvu River, the latter as part of the investigatory work which this Division is carrying out for a French Technical aid team. In all 29 holes, totalling 1,107 ft. were drilled.

45. The soil and water-testing laboratory at the Project Planning Station was brought to a high standard by a generous gift of equipment from the Food and Agriculture Organization of the United Nations, and it is now capable of carrying out soil tests for most Divisional purposes, also analyses of water samples for domestic potability. During the year 397 soil samples were tested for engineering properties and 310 water samples for domestic and/or irrigation use.

VI.—HYDROLOGY

46. The Hydrological Section, based on the Project Planning Station at Ubungo, is currently being re-organized following the attachment of a Food and Agriculture Organization Hydrologist in the early part of the year, and the appointment to the permanent establishment for the first time, of a Senior Hydrologist later in the year.

47. When re-organization is complete, direct control of all main hydrological work will be centered on Ubungo and "in-service" training of hydrological staff (which has already commenced) will form an important part of the work.

48. A complete re-assessment is being made of all existing gauging stations, with a view to a rise of standards to internationally accepted levels, and leading to a general streamlining of the hydrological organization.

49. It is proposed that the main link between the central organization and field workers will be through Regional Hydrological Officers, who will take over duties formerly carried out by the Regional Water Engineers. One Regional Hydrological Officer was established in Tanga to cover operations in the busiest area, comprising the Northern and Tanga Regions others will follow as staff and funds become easier.

50. The implementation of the re-organization plan has placed a considerable amount of extra work on Ubungo staff, and more experienced staff at the higher grade of Technical Assistant level are urgently required, particularly since the loss of such staff during the year. This problem must be overcome, particularly as the amount of "in-service" training that can be given to junior staff depends on senior staff being able to spare time for this work. Experience this year with "in-service" training has shown that excellent results can be obtained, especially with staff already having experience in lesser hydrological duties who are keen to fit themselves for higher posts. The training of newly appointed staff requires considerable extra time. Undoubtedly a separate training establishment for hydrological specialist staff is now required if the important work done by this section is to continue at the present rate, let alone expending its activities to cover further important areas of the country.

51. The Hydrological Year Book was prepared for the printers in November. The Year Book, which covers the period 1950-1959, includes 88 "A" and "B" Regular Gauging Stations; 110 "C" Stations; and 46 unclassified stations with gaugings included prior to rating. "A" stations are classified with regard to their position and reliability in the individual catchments. "B" stations are classified on a similar basis, but are complementary to "A" stations in respect of overall consideration of the hydrological network. "C" stations are those which do not rate well, or have a paucity of records. All "A" stations have hydrographs appended. The Year Book is expected to be published in the early part of 1963.

52. During the first half of the year, field gauging programmes and other activities were considerably curtailed because of the abnormal rains, interruption of communications, and general flooding. Particularly affected was the intended erection of several new gauging installations, the Kilombero catchment suffering most in this respect. The team at Steigler's Gorge, Rufiji, was isolated from February to June and an air drop had to be made to supply them with food. The station at Furua, on the Kilombero, was found to have suffered complete change of control because of excessive bank and bed erosion and it is no longer of any value as a Regular Gauging Station. Damage to other installations was not found to be excessive, considering the extent and duration of the floods, but nevertheless many repairs and re-surveys had to be carried out.

53. The Current Meter Rating Tank at Ubungo was constructed and all that now remains to be done, in order to utilize the tank, is the installation of the rating equipment, for which an allocation of funds is awaited. A useful consignment of automatic water level recorders and gauging equipment was received, the former being earmarked for several important Regular Gauging Stations—the installation of automatic water level recorders will lead to a great improvement in the accuracy of records from these stations.

54. Two new Meteorological Stations were established, one at Kyela, Rungwe District, Southern Highlands Region, and the other at Wami Prison Farm in the Wami catchment; also, improvements were made to Lumemo Meteorological Station at Ifakara. The important recorder at Kidatu on the Great Ruaha was removed prior to re-siting at a more suitable location. Cable-car installations were erected over the Lufirio and Ruhuhu rivers in Southern Highlands Region, and many improvements to control at several gauging stations were carried out.

55. The demand for hydrological information was again very heavy, due mostly to an increase in survey and investigation teams from abroad who covered several potential irrigation areas in the Eastern Region, particularly the Kilombero Valley and the Ruvu Basin. The Project Planning and Research Station, Ubungo continued to supply information on stage-discharge relationships on the Pangani River to Sir William Halcrow and Partners, Consulting Engineers, for their investigations into the proposed Nyumba ya Mungu dam.

56. Considerable information was requested by the Water Officer for hydrological studies in respect of applications for water rights throughout the country, and the close exchange and reciprocity of information with the East African Meteorological Department at Dar es Salaam was continued.

VII.—MAJOR PROJECT PLANNING

57. As in previous years, considerable emphasis has been placed on the study of major water development and irrigation projects in different parts of the country; these projects include general utilization of the water resources of the Pangani River Basin, with special stress on hydro-electric power and irrigation; flood control and irrigation in the Ruvu River Basin; pilot irrigation schemes in the Kilombero tributary of the Rufiji River, and also in the Lake Victoria catchment; and finally general development of the water resources of the Wami River Basin.

58. Following the appointment in 1961 of the Engineering Consultants, Sir William Halcrow and Partners, with wide terms of reference covering the water resources of the Pangani River Basin, investigations and survey work continued in the field during the first half of 1962. This work has embraced many aspects of the problem, including agronomy and soils, as well as engineering and hydrology. The Consultants' preliminary draft report was received in November and their final report is expected early in 1963. There is every reason to hope that as a result of the encouraging nature of the report the way will shortly be clear for major development works within the Pangani River Basin, leading to large scale irrigation schemes and augmented supplies of electricity generated by hydro-electric power.

59. With the outline plan for development of the Ruvu River Basin, prepared by Mr. Chablani and issued by F.A.O. in 1961, as an invaluable basis for more detailed studies, French technical aid teams have been in the field for much of the year commencing with a reconnaissance party from January to April. Other teams followed and, in close collaboration with the W.D. & I.D. and other Divisions of the Ministry, preliminary plans were prepared for the pilot irrigation schemes; also for a programme of exploratory drilling and topographical mapping at Kidunda, where conditions favour a major flood control dam.

60. The sites selected for the two pilot schemes are at Kwala, in the lower Ruvu Valley and at Mvuha, situated below the south-east slopes of the Uluguru Mountains; in each case the schemes are being designed for approximately 800/1,000 acres in the initial stages. At Kwala, the cultivated area will be protected by a polder in the flood plain and served by pumping and drainage facilities. For the Mvuha scheme, gravity irrigation is intended with an off-take structure sited on the Mvuha River. Survey and design work is well advanced at Kwala, but in the case of Mvuha it is still in the early stages.

61. The reach of the Ruvu River between Kidunda village and the confluence of the Mgeta tributary has for some years received special attention as offering favourable conditions for construction of a major flood control dam. This year, in collaboration with members of the French Technical Team, W.D. & I.D. has carried out an extensive programme of diamond and percussion drilling, combined with the measurement of permeability. In addition, this reach of the river has been resurveyed and contoured maps have been prepared.

62. Among the more important pilot irrigation schemes recommended for study in the Rufiji Basin Survey Report was Lumemo, situated near Ifakara in the Kilombero Valley. A technical expert made available by the Swiss Government visited the area during the year and submitted proposals for preliminary surveys and investigations aimed at the design of an irrigation scheme, which might ultimately extend over 2,500 acres. A Water Development and Irrigation Division survey team prepared the necessary contour plans covering both the headworks site and the irrigation area and these have since been dispatched to Switzerland for incorporation in the project proposals.

63. The importance of the irrigation development potential in the Lake Victoria catchment area has long been recognized and, with Israeli technical aid and the active support of the Victoria Federation of Co-operative Unions, a 50-acre pilot pumped irrigation scheme is now in operation on the eastern shores of Smith Sound. The pumping equipment and distribution piping were installed at short notice and with great speed by W.D. & I.D. and the results of the experimental work are being watched with interest.

64. As in previous years, this Division has been responsible for the provision of technical advice in the engineering sphere to the Tanganyika Agricultural Corporation irrigated farm at Mbarali. A potentially serious river training problem upstream of the main headworks was studied during the year and a report submitted. In addition, an accelerated development programme was drawn up, combined with estimates of capital and recurrent costs, for both gravity and overhead irrigation.

65. Problems connected with the waters of Lake Victoria in the Nile catchment have called for considerable study and discussion, including several meetings of the East African Nile Waters Co-ordinating Committee. Informal technical talks were held between representatives of the three East African countries and the Permanent Joint Technical Commission (representing Egypt and the Sudan) in Nairobi and Kampala in July; these talks attended by the Director of W.D. & I.D. served a very useful purpose, and the decision was then taken to continue the discussions in Cairo in March, 1963. The approach to the problems of discharge control and storage in Lake Victoria have been considerably complicated by the unprecedented rains and lake levels experienced in 1961/62 and have necessitated reviews and reconsideration of theories on the Lake's behaviour previously accepted as reliable.

VIII.—DOMESTIC AND CATTLE WATER SUPPLIES

66. The water supplies discussed in this chapter, except those mentioned in the final paragraph, are for domestic and stock use, and were all provided at the request of the Local Authorities. Normally each scheme received 75 per cent assistance from Government, but in the case of some small projects, the Local Authority paid the full amount. Upon completion, each scheme is handed over to the Local Authority to whom it then belongs, and upon whom falls the responsibility for maintenance and operation. Government assists with maintenance only upon request and reimbursement of cost.

67. There is always a great demand for water supplies of this type, and the limiting factor is the availability of funds. There are many cases where the Local Authority cannot meet the 25 per cent contribution, resulting in the scheme being dropped and the number of such cases has risen greatly in Central and Northern Regions during 1962, as a result of famine and flood. The inability of some Local Authorities to find the 25 per cent share, has not as yet affected the total output of water supplies, but it has tended to shift the bulk of the work into those areas where Local Authorities are more affluent. Such areas are Lake Region generally, and Kilimanjaro District. There has been an upsurge in the construction programme in Tanga Region, for the same reason.

68. During the year 59 new domestic water supplies were under construction, and in addition, improvements and extensions were carried out on 22 existing schemes. Of the new supplies under construction, 30 were completed and are now in operation, and 11 improved supplies were put into service. Of the new supplies 21 were gravity pipelines and pumped supplies from springs or streams, making available an additional 1,070,000 gallons of water per day. Nine storage reservoirs were completed, to conserve an additional 1,011 acre feet of water. With reference to reservoirs, the tendency in the Division is to move over to the construction of smaller dams and charcos, and away from the bigger dams: this will encourage the dispersal of water supplies, and should lead to larger numbers of small but adequate supplies.

69. The works carried out in the various regions are described briefly below, and further details are given in Appendix I:—

(a) *Eastern Region.* A dam and a pumped water supply were provided to St. Andrew's College, Minaki, also work was under way on 4 borehole water supplies for domestic and cattle use in different areas. An earth dam was constructed at Gairo in Kilosa District, for domestic and stock purposes, and three wells were sunk for the Forest Division in Morogoro District.

(b) *Central Region.* Two earth dams were constructed for domestic and cattle watering, and repairs and improvements were under way on six others. Eight pumped supplies from boreholes for cattle and domestic watering were under construction, of which four were completed.

(c) *Western Region.* One earth dam for domestic and cattle watering was completed during the year, and improvements carried out to another.

(d) *Lake Region.* Four earth dams, and three charcos, were completed or under construction for domestic and cattle supplies. In addition, improvements and repairs were carried out on four dams. Three pumped water supplies were provided, one from Lake Victoria, one from a borehole, and one from a sand river.

(e) *West Lake Region.* One new pumped supply using a hand-pump on a borehole was put into service, and minor improvements were carried out to the intake of a pipeline. Automatic water dispensers were installed in existing water kiosks at three water supplies constructed in previous years. An extensive borehole drilling programme is under way.

(f) *Northern Region.* Fifteen gravity pipelines providing cattle and domestic water were under construction, of which ten were completed. In addition, improvements were carried out to four others. One small earth dam was constructed to provide water for the Coffee Research Station at Lyamungu.

(g) *Tanga Region.* The construction of one earth dam was completed. Three gravity supplies were under construction, two of which were completed, and four pumped supplies from boreholes, two of which were completed. In addition, improvements and extensions were carried out to three water supplies. The construction of wells continued in Handeni District.

(h) *Southern Region.* No new construction of water supplies was possible, due to lack of Local Authority Finance.

(i) *Southern Highlands Region.* The improvement of springs continued in Mbeya District, and the construction of wells in Njombe and Chunya Districts.

70. *Government Minor Settlement Water Supplies.* Work commenced on two new water supplies for Pangani and Sanya Juu. Phase I of the Pangani water supply was almost completed, and a start made on Phase II. At Sanya Juu, the work was brought to a very advanced stage. Work also commenced on major improvements to Kiomboi water supply, where the source of water was changed from a dam to a borehole. At Igombe Dam, which is the source of water for Tabora Township, work was put in hand on major spillway improvements, consisting of the extension of the existing concrete falls, from 100 ft. in length to 240 ft. This work was found necessary as a result of unprecedented floods in early 1962.

IX.—IRRIGATION AND FLOOD CONTROL

71. Tanga Region continued as in the previous year to be the centre of the greatest demand for the development of village irrigation. The people in the highlands of the Pare and Usambara mountains have a tradition of irrigation practice and their keeness to obtain additional irrigated land to relieve the over-crowded conditions in the mountains will be assisted by Government in every way possible. The soundest and quickest development of irrigation will be obtained in those areas where the people are used to irrigation and show a desire to expand it.

72. The extensive floods of 1961 were followed in 1962 by floods of almost the same intensity, and protection and repair works started during the year, as a result of the previous year's depredations, were faced with further damage at the end of the year. It is a measure of the continuous improvement in design and construction of flood control works that further damage caused by the 1962 floods has been relatively small. During the year flood protection works continued at Mkundi River and Mlali Irrigation Scheme (both in Eastern Region), and work on flood protection dams at Dabalo, Hombolo and Buigiri (all in Central Region), continued. Works were in progress on irrigation schemes at Kitivo, Kalimawe, Mbarali, Kalenga, Ilonga, Mlali and Mbarika, as follows:—

Kitivo Irrigation Scheme. The main channel, started in 1961, was extended by 7,000 ft. to bring the full area of the scheme under command. This work completed the main distribution system and the local cultivators are now engaged in developing the area to its full extent of 1,000 acres.

Kalimawe Irrigation Scheme. Some 800 acres are now under cultivation below the high-level channel and there is an increased demand in the area for land commanded by the channel. A diversion bund on the high side of the main channel, with cross-drainage structures, protecting the channel from surface water runoff was completed during the year, and allowed general improvement in the maintenance of the channel itself. Kalimawe Dam filled during the year, and the large amount of water flowing to waste over the spillway has strengthened the demand for the dam to be raised by 5 ft. to store an extra 13,000 acre feet which could provide additional water in the dry season for another large area.

KITIVO IRRIGATION SCHEME

Irrigation Regulator in main Canal (viewed from Upstream)

Mbarali Irrigation Scheme. Unusually severe floods experienced during the year again caused anxiety as to the effect these would have on the river meanders and particularly on the headworks of the intake to the main irrigation channel. While some damage to the river banks took place upstream of the headworks, it was not excessive and only minor protective works were necessary. A problem has however been created by heavy silting at the entrance to the headworks and methods of overcoming this are being studied. Responsibility for the running of the irrigation scheme lies with the Tanganyika Agricultural Corporation, but the W.D. & I.D. provides technical advice on engineering problems. During the year this included the construction of a syphon under a service road, and a foot-bridge across the main channel. 505 acres are now under cultivation, both directly by the Corporation and by tenant farmers.

Kalenga Irrigation Scheme. Repairs to the severe flood damage to the main channel caused in the previous year were put under way. These consisted of culverting 830 ft. of the main channel where bank subsidence was likely and the replacement of a stream over-crossing by a 2 ft. dia. syphon, 90 ft. in length. At the end of the year the work was practically complete.

Ilonga Irrigation Scheme. A 3,000 cusec flood in April demolished the rubble masonry breaching section of the weir. This was replaced by a gabion structure which has so far withstood heavy flooding. At the end of the year the pipeline from the weir to the small irrigation experimental plot was completed and is now in operation.

Mlali Irrigation Scheme. The continuance of high floods over 1961/62 caused damage to the regulator in the river and washed away the right bank bund immediately upstream allowing the flood water to flow directly on to the irrigation area, ruining some of the paddy crops and depositing a large amount of sand and silt in the area. Extensive repair and improvement works were carried out to the regulator and to the right bank and these were completed by the end of the year. A flood protection bund and drain was laid along the right bank of the river between it and the irrigation area, and this work was also finished at the end of the year. This irrigation scheme continues to be popular and the possibility of extending it, which will require a search for an additional water source, is being considered.

Mbarika Pilot Irrigation Scheme. In conjunction with the Government of Israel and the Victoria Federation of Co-operative Unions, 40 acres of land were selected close to the south shore of Lake Victoria, and works for a pumped irrigation scheme, using the waters of Lake Victoria designed. Water will be led on to the fields by gated pipes laid on the surface and there will be a small experimental plot for overhead sprinkler irrigation. The work was completed most expeditiously to enable the farmers to plant cotton in December. It was not necessary, owing to the heavy rains, to irrigate at the time of planting, but the use of fertilizers has already shown encouraging early results in the growth of the cotton. If this small pilot irrigation scheme is successful, it is proposed to try out similar schemes in other parts of the lakeside area.

Mkundi River Training Works. Some damage to the earth embankment on top of the gabion training wall forming the left bank of the river was sustained during severe floods. The earth bund was repaired and the opportunity was taken to strengthen the gabion wall and extend it. Some 3,000 cu. yds. of rock in gabions were placed, and a further 1,000 cu. yds. collected and laid beside the wall for emergency repairs. Training fences are being erected in the river in a further attempt to keep it on a definite course and encourage deposition between the fence and the gabion wall.

Mbuguni Flood Protection Works. After the severe damage caused by the 1961 floods, reconstruction was put under way and completed during the year. The works consisted of laying a 3 ft. dia. Armco culvert 80 ft. in length, with penstock, trash grill and downstream measuring flume. Pitched protective works were carried out on the right bank of the river. The increased size of the culvert allows for a flow up to 100 cusecs and as the area commanded is very popular, increased areas under irrigation are expected.

Kinyasungwe River Flood Control. No new flood control works were carried out during the year, but improvements to three existing flood control dams at Dabalo, Hombolo and Buigiri were necessary. These three dams, together with Ikowa, play a major part in storing flood waters of the Kinyasungwe River at a critical time and prevented the almost-annual washing away of main roads and railways.

X.—DAM CONSTRUCTION

73. The year followed almost exactly the pattern of 1961, with floods throughout the whole country and famine in the drier central regions. The unusually heavy rains at the end of 1961 carried over into 1962 and, in combination with insects, ruined this Year's crops in parts of the country. Famine relief works were however confined this year to communal Nation Building projects, including small hand-built dams, and the larger dams were constructed solely by machinery. The two successive years of famine have been a drain on the resources of local authorities and little money has been available for water supplies generally, and dams in particular. As a result there was a decided drop in dam construction, and only 9 dams and reservoirs were completed, involving 319,200 cubic yards of earth placed and resulting in an increase of 1,011 acre ft. in water storage capacity.

74. No additional earth-moving machinery was purchased and the earth-moving teams consist of; one team of 3-Caterpillar D.W. 15s push-loaded by 1-Caterpillar D.8 and 1-Caterpillar D.7, two teams of 5 and 4 Tournapull D Roadsters push-loaded by Caterpillar D.7, and 5 teams of Caterpillar D.4s. The integration of the Soil Conservation Unit into this Division meant an additional 2 Track-Marshalls and scrapers for the D.4 teams.

75. All dams constructed are detailed in Appendix I of this report. In the following paragraphs a brief description is given of points of interest of some of the larger dam works carried out during the year.

Igombe Dam. The 1961 floods which caused such severe damage to the spillway of this dam, Tanganyika's largest with a capacity of 38,500 acre feet, continued well into the, beginning of the year and it was impossible to survey the damage and prepare designs for the repair until April, leaving very little time before the remedial works could be finished to deal with expected floods at the end of 1962. The designs were completed and a contract to the value of £65,000 awarded in July. Although preliminary progress was unsatisfactory, work proceeded at a reasonable rate thereafter, but unfortunately early floods started in November and practically all work in the spillway had to stop. The floods at the end of 1962 have almost reached the same intensity of those in 1961. Additional works on the down-stream side of the main outlet canal were completed and it is now possible for the sluice gates to be fully opened without causing damage downstream.

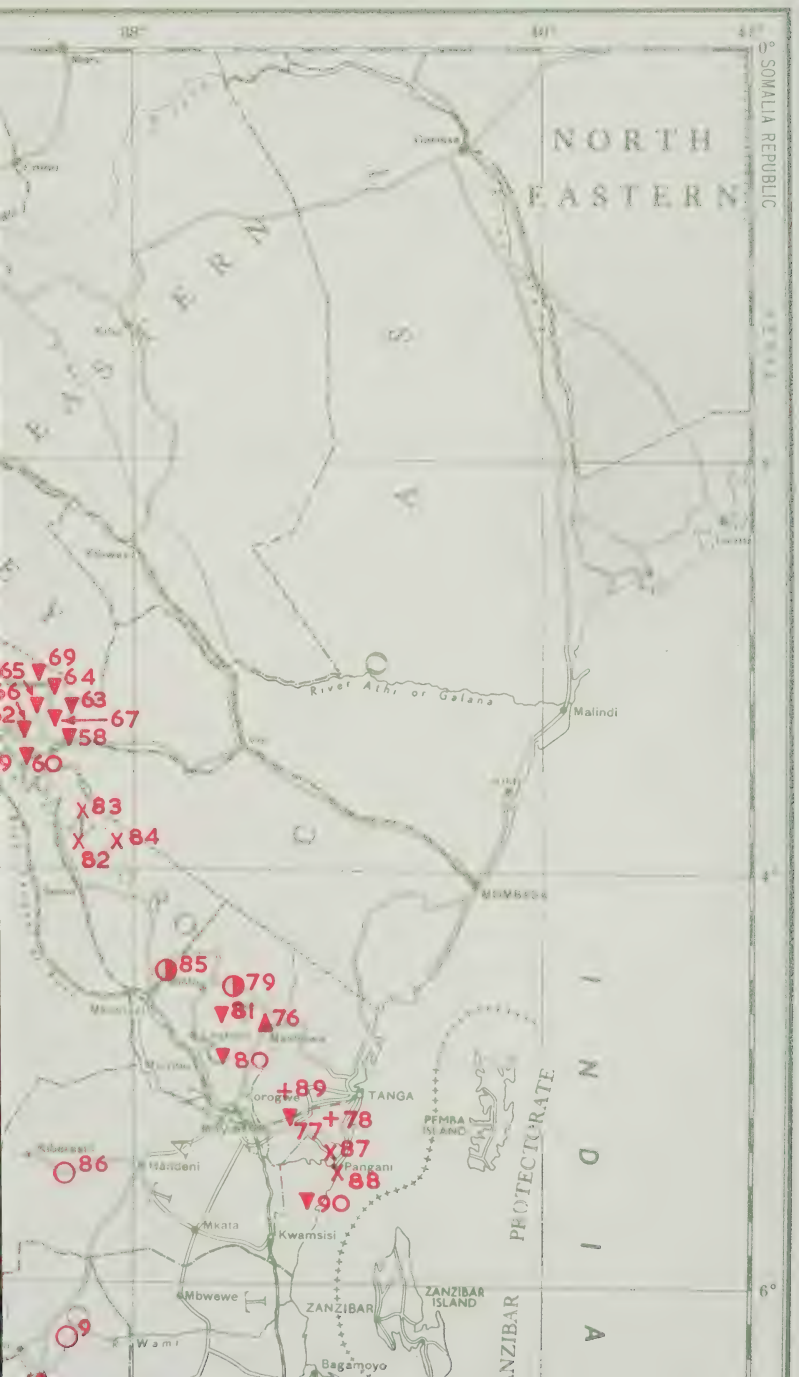
Matambulu Dam. This dam was breached in 1961 as a result of a combination of an insufficiently compacted core wall of poor material and an undiscovered deep-seated spring. Work on repair started during the year and was almost completed. The spring was sealed off and led downstream and a new cut-off wall excavated and refilled with an impervious core material, moistened and rolled to specification. The main embankment was then rebuilt and 31,500 cubic yards of material placed.

Dabalo Dam. A small slip took place in the downstream face of the embankment necessitating the installation of a drainage system which proved effective, and the opportunity was taken to construct a new guide wall to the spillway and a permanent outlet channel from the draw-off tower.

Wiyenzele Dam. Work re-started on this 920 acre ft. capacity dam, 1,400 ft. long and 38 ft. high, after the cessation of work by flooding in 1961. 88,000 cubic yards of material were placed in the embankment, including the impervious core. Concrete crest walls were built in the spillway, also masonry and concrete drop walls in the spillway tail. However, a severe storm in the catchment caused an unexpected rapid filling of the dam basin, a weakness was found and the embankment was breached. Investigations were put in hand immediately to discover the cause of the failure.

Dams in Lake Region. Small dams continue to be very popular in this area and during the year work was under way on 9 dams and 4 charcos with keen demands for more. While not having the glamour of the larger dams, these small, strategically-spaced dams, are gradually building up an overall cover of permanent water supplies throughout the whole Region. The policy of smaller but more frequently spaced dams for cattle and domestic use is strongly advocated by this Division as the question of control of cattle and soil erosion becomes so much easier to deal with.

MAP I


NORTH EASTERN
0° SOMALIA REPUBLIC
River Athi or Galana
Malindi
Mombasa
TANGA
PEMBA ISLAND
PROTECTORATE
Pangani
Kwamsisi
Mbwewe
ZANZIBAR
ZANZIBAR ISLAND
Bagamoyo
Wami
6°
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WATER DEVELOPMENT & IRRIGATION DIVISION

TANGANYIKA

MAP I

LAKE VICTORIA
NYANZA
RIFT
CENTRAL
EASTERN
NORTH EASTERN
SOMALIA REPUBLIC
KENYA
UGANDA
TANGANYIKA
NYASALAND
NORTHERN RHODESIA
SOUTH WESTERN HIGHLAND
SOUTHERN HIGHLAND
EASTERN
PROTECTORATE
ZANZIBAR
Mbarara
Kisumu
Londiani
Nakuru
Kericho
Kisii
Nyeri
Meru
Embu
Garissa
Naivasha
Narok
Kajiado
Nairobi
Kisii
Musoma
Shirati
Mwanza
Nyalikungu
Tinde
Arusha
Moshi
Kondoa
Dodoma
Kilosa
Morogoro
Mpwapwa
Bagamoyo
DAR ES SALAAM
Mboamaji
Mafia Island
Mbeya
Iringa
Ifakara
Sao Hill
Kibau
Mahenge
Malinyi
Mwaya
Lupembe
Mohoro
Kilwa Kivinje
Njinjo
Kilwa Masoko
Ruangwa
LINDI
Ruponda
Nachingwea
Mikindani
Tukuyu
Kyela
Abercorn
Fort Rosebery
Fife
Mpika
Chinsali
Isoka
Kasama
Mbala
Tunduma
Sumbawanga
Kigoma
Ujiji
Kasulu
Kibondo
Kabanga
Biharamulo
Bukoba
Kyaka
Kyaka Mission
Ngara
Rulenge
Kahama
Shinyanga
Maswa
Bariadi
Mwanza
Geita
Nzega
Tabora
Kondoa
Singida
Kilimatinde
Manyoni
Kigwa
Mpwapwa
Kilosa
Morogoro
Mohoro
Kilwa Kivinje
Kilwa Masoko
Njinjo

MAP II

38°
40°
41°
NORTH EASTERN
S. SOMALI REPUBLIC
KENYA
Garissa
Kitui
Kitwezi
River Athi or Galana
Malindi
MOMBASA
Samo
Mlalo
Mashewa
Mombo
Korogwe
TANGA
PEMBA ISLAND
Kiberashi
Handeni
Pangani
Mkata
Kwamsisi
Mdwewe
ZANZIBAR
ZANZIBAR ISLAND
Wami
Bagamoyo
PROTECTORATE
INDIAN
4°
6°
O5
O4
O8

WATER DEVELOPMENT & IRRIGATION DIVISION

TANGANYIKA

MAP II

Polyconic Projection

© TANGANYIKA GOVERNMENT 1963

BOREHOLES DRILLED ○

Scale 1 : 4,000,000

Kilometres 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 Kilometres

Miles 20 0 20 40 60 80 100 120 140 160 180 Miles

REFERENCE

International Boundaries ——— Roads ———

District - - - - - -

Compiled, Drawn and Printed by Dept. of Lands & Surveys
Dar es Salaam Tanganyika 1958
Revised and Reprinted 1963

LOCATION MAP OF BOREHOLES COMPLETED & IN HAND 1962 — APPENDIX II

XI.—WATER BORING

76. Geological-geophysical surveys for borehole sites were carried out in all Regions except Western, Southern Highlands and Southern, as follows:—

Central	...	11
Eastern	...	4
Tanga	...	5
Northern	...	7
Lake and West Lake	...	11
Total	...	38 Surveys.

77. Of the total number of surveys, 25 were undertaken for Local Authorities, District Councils, and National Building (self-help) schemes; one for Wami Prison and one for the Agricultural College in Eastern Region, Morogoro; one for the Mkomazi Game Reserve in Tanga Region and one at Seronera Camp in the National Park. For private clients eight surveys were carried out, comprising two for Sisal Estates in Tanga Region, two for Missions in Lake Region, and four for other private estates in Northern Region. One exploratory survey was performed across the Makatupora Depression, the source of Dodoma's water supply, in an attempt to elucidate its structure and the depth of the over-burden.

78. From the above it can be seen that 65·8 per cent of the surveys were carried out for Local Authorities, 10·5 per cent for Government Departments, 5·25 per cent each for Sisal Estates and Missions and 10·5 per cent for other private clients.

79. The total number of resistivity depth probes during the year was 271, with the depth-range from 150 to 700 feet, and 15 constant-separation traverses totalling 38,170 feet were traversed, sounding strata at constant depth between 100 and 200 feet.

80. Geophysical forecasts were found to be in general agreement with the drilling results. Of 23 holes completed 17 were put, or are awaiting to be put, into commission which makes the rate of success 73·8 per cent. Borehole 35/62 still being drilled, and a replacement for Borehole 5/61 drilled in 1962 are not included in the rate of success. Of those abandoned, two holes (1/62 and 28/62) were dry, three holes (3/62, 4/62 and 17/62) met insufficient yield for the needs required and one hole (29/62) struck 216 g.p.h. of brackish water. The twice unsuccessful drilling at Mipa which struck fresh granite at 27 ft. probably resulted from misinterpretation of survey evidence.

81. Exploratory drillings were carried out at Kidunda in Eastern Region and at Jangalo in Central Region, both for proposed dams. With the Percussion Rig seven holes 6″ diameter totalling 280 feet were drilled and with the Soil Sounding and Boring L.W. Rig, 77 feet were drilled. The Diamond Rotary Rig was operating in 29 holes totalling 106 feet drilled through over-burden and 1,001 feet drilled through Usagaran foliated gneisses and Jurassic shales, mudstone and sandstone. The overall core recovery from the latter two formations was 49·4 per cent. For the first time all exploratory holes were subject to permeability tests under falling and/or constant water head, which appeared to be a desirable and very useful supplement to the sounding of the strata condition.

82. The total footage drilled for water supplies was 5,867 feet including 112 ft. of replacement drilling (5/61). Of this 3,654 were drilled in successful holes. The length of casing inserted into producing holes was 309 ft. of 8″ and 2,725 ft. of 6″ diameter. Six holes were gravel-screened to exclude silting. The output of footage drilled in various Regions was: in Central 1,751 ft; Lake 1,128 ft.; West Lake 1,200 ft.; Eastern 1,309 ft. and in Tanga 479 ft. The total yield from successful boreholes was 28,835 g.p.h.

83. *Groundwater Geology.* The granitoid Shield's top weathered zone gave good yields of about 1,500 g.p.h. to two boreholes (32/62 and 33/62) in Iramba area and to two boreholes (19/62 and 20/62) in Maswa area, medium yields of 250/560 g.p.h. were obtained elsewhere. The terrestial cemented deposits 90 ft. thick pierced through at Mtita south of Dodoma (1/62) appeared to be drained.

84. Good yields were struck again in weathered gneisses of the Usagaran System in the notable area east of the Busi-Chungai fault in Kondoa area. However, drilling into weathered biotite-hornblende gneisses north of Lushoto within the Usambara Mountains produced only a trickle of water, presumably being drained by some camouflaged fault.

85. Nyanzian Schists produced good supplies of 1,500 g.p.h. in two boreholes one on Iramba Plateau (5/62) and one in Maswa area (34/62).

86. Soft phyllites of Karagwe-Ankolean System appeared again to provide chancy and risky aquifers by yielding only scanty water to two holes. However, borehole (17/62) drilled south of Kyaka struck 1,320 g.p.h. in jointed hard shales overlying soft (water tight) phyllites.

87. Calcareous shales sandwiched between thin beds of fine grain sandstone and thin beds of limestone of the Jurassic System gave disappointing though useful yields of 200/300 g.p.h. to three fairly deep boreholes.

88. The marine Tertiary deposits at Kipumbwi (2/62) south of Pangani produced 9,000 g.p.h. of good quality water.

89. One borehole drilled into Quaternary alluvium consisting of clays intercalated with lenticles of sands and gravel on the north-west fringes of the Kimamba Flats at Mvomero struck 3,000 g.p.h.

90. *Quality of Groundwater.* Most of the water abstracted during the year was potable and only one hole was abandoned due to high salinity content. High total dissolved solids of 5,442 p.p.m. and an excessive total hardness of 1,500 p.p.m. were recorded on water from Saga-Saga borehole only, drilled into Jurassic calcareous shales. Fluoride content, apart from three holes at Kinampanda on Iramba Plateau, at Sayu-Sayu in Shinyanga and Nyakato near Mwanza where it was noted to be 4·0, 5·0 and 4·8 p.p.m. respectively, did not exceed 2·0 p.p.m. Water from Choda borehole in Singida area showed 143·0 p.p.m. of nitrates, trace or nil being recorded for all other waters.

XII.—PLANT AND WORKSHOPS

91. The shop maintenance of mobile plant and vehicles has now been handed over to the Electrical and Mechanical Division of the Ministry of Communications, Power and Works, with the exception of Central Region where the mechanical amalgamation has not been implemented yet, and maintenance will remain under Divisional control until June next year. To facilitate fabrication of small items and sundries for water supplies and irrigation schemes all Regional offices continued to maintain small workshops of their own.

92. On the 31st December, 1962, the W.D. & I.D. earth-moving fleet consisted of the following teams:—

(a) Four Caterpillar D4 tracked teams 3-6 units in each, equipped with 4 cubic yard scrapers operating in the Northern, Western, Eastern and Tanga Regions.

(b) One Caterpillar D7 tracked team with 9-13 cubic yard scrapers, in the Central Region.

(c) Two teams of Tournapull Model "D" 7 cubic yard wheeled Tractor/Scrapers, 4 and 5 units each team, with 1 and 2 Caterpillar D7 Bulldozers for push-loading, in the East Lake Region.

(d) One Caterpillar DW.15 wheeled team of 3 machines with 13 cubic yard scrapers and one D8 Caterpillar Bulldozer for push-loading, in the Central Region.

(e) In the latter part of the year the Division acquired a team of 5 Marshall Crawlers with 6 Preco Terracers and 2. Onions 4 cubic yard scrapers from the Mechanical Services Unit, Tengeru. Apart from the above equipment, there is a number of Caterpillar D4 and D2 Tractors in use in various parts of the country, and a 955 Model Caterpillar Traxcavator in Tanga Region.

93. The total quantity of earth moved mechanically in construction of earth dams and irrigation projects in 1962 was 319,200 cubic yards, compared with 362,500 cubic yards in 1961. The reduction in output is attributed mainly to scarcity of funds and a prolonged and unusually intensive rainy season.

94. The process of replacing unserviceable fixed body load carriers and short wheel base Tippers with dual purpose long wheel base Tippers was continued, and the Division took delivery of 9 long wheel base Tippers in 1962. Further, two Leyland Comet vehicles were received, replacing obsolete Thornycroft lorries used for drill rig towing and other heavy haulage, and orders were placed for five more with delivery scheduled early in 1963.

This would bring the total number of Leyland Comet 4×4 vehicles to eight, replacing almost completely the fleet of Thornycroft Nubians. A Leyland Super Hippo 6×4 heavy tractor ordered in September, 1961, has, due to numerous complications in manufacture, not yet been delivered. It is however now nearing completion, and should be ready for shipment in February, 1963; it will be used to haul an 18-ton Carrymore Lowloader for transportation of Caterpillar D7 Tractors.

95. The total number of accidents in which Divisional vehicles were involved in 1962 was 18, resulting in 4 deaths and 9 injuries. This compares with 19 in 1961, involving 3 deaths and 10 injuries.

96. A list of transport, contractors' Plant and earth-moving equipment appears at Appendix IV.

XIII.—MAINTENANCE OF LOCAL AUTHORITY WATER SUPPLIES

97. The standard of maintenance of the Local Authority water supplies continues to be with a few exceptions, unsatisfactory. The assistance of the Ministry of Local Government has been obtained in an effort to bring home to Local Authorities the fact that unless dams are maintained in good order they will be faced with large sums of money for their repair later on, or with compensation for damage caused through dams being breached leading to crops spoilation and perhaps loss of life. This Division instituted a routine inspection system for major dams, and these are now inspected at least once and where possible twice per annum, and a detailed report on their condition sent to the Local Authorities concerned. By detailing the matters which require attention some notice is being taken and remedial action started, but generally speaking the standard of maintenance of dams and other water supplies is deplorably low.

XIV.—CONCLUSION

98. Although some setbacks have been suffered during the year due to unfavourable weather conditions and other causes, the achievements and general progress recorded in the previous chapters can be regarded as very satisfactory. Of particular significance are the advances made in major project planning, the results of which are likely to be reflected in large scale construction projects in the near future.

99. Great credit is due to the staff, who have continued to display keeness and devotion to duty of a high order, and there is no doubt that the previous Director, Mr. I. L. Ward, who departed on retirement in May, would wish to be associated in this expression of gratitude to all ranks for their untiring efforts and loyal co-operation.

S. L. Paterson,
Director of Water Development and Irrigation

Dar es Salaam,
May, 1963

APPENDIX I

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	EASTERN REGION		
	Kisarawe District:		
1	Project Planning Station, Ubungo.	Construction of rating tank	4,000
		Construction of two Student's quarters	3,300
		Alterations and additions be offices	1,500
2	St. Andrew's College Water Supply, Minaki.	Earth dam and pumped supply to College. Dam height 23′, length 253′, earthwork 4,600 cu. yds. capacity 40.4 acre ft. 4,790″ of 3″ dia. rising main to 20,000 gallon storage tank. Delivery 2,000 g.p.h.	2,706
	Morogoro District:		
3	Mvomero Water Supply.	6″ dia. borehole 205′ deep, fitted with pump and engine. Output 3,000 g.p.h.	1,62
4	Saga Saga Water Supply	6″ dia. borehole 400′ deep, yield 240 g.p.h.	1,725
5	Gronero Water Supply	8″ dia. borehole 366′ deep, yield 320 g.p.h.	1,498
6	Mkulazi Water Supply	Drilling of borehole commenced First water at 205′.	470
7	Mngugo Water Supply	Drilling of borehole commenced.	—
8	Mlali Irrigation Scheme	Alternation to R.B. Abutment and channel diversion. Extension of stilling bay.	3,324
		Extension to flood bund and main drainage line.	700
9	Mtibwa Wells	Three wells for Forest Division 3′ dia. and 15′ deep.	215
	Kilosa District:		
10	Gairo Dam	Earth dam for domestic purposes. Height 14′, length 650′, earthwork 8,000 cu. yds. capacity 1.7 ac. ft.	3,131
11	Mkono wa Mara Middle School Water Supply	Pumped water supply. 900 ft. of 1½″ dia. pipe from well to 3,200 gallon storage tank.	202
12	Ilonga Irrigation Scheme	Alteration to weir on Ilonga River. Laying 1,800 ft. of 8″ dia. steel pipe to carry ½ cusec.	973
13	Mkundi River Training	Conversion of gabion wall from light to heavy section, including additional protective gabions and earthwork on embankment.	9,000
	Ulanga District:		
14	Construction of Automatic Recorder House at Swero	Job partially completed but work abandoned at onset of rains due to inaccessibility of site.	100
	CENTRAL REGION		
	Dodoma District:		
15	Dabalo Dam Improvements	Drainage works, spillway guide wall and Attendant's quarter constructed at this earth dam, which has a height of 48′, length 1,400′, earthwork 248,000 cu. yds. and capacity of 5,210 ac. ft.	4,564
16	Hombolo Dam Spillway	A new toe wall along the guide wall of the spillway, and a new crest wall at the tail of the spillway were completed.	1,738
17	Matumbulu Dam	Reconstruction of breached earth dam.	9,529
18	Mlowa Dam	Earth dam for domestic and cattle watering, height 33′, length 1,900′, earthwork 47,000 cu. yds. capacity 900 acre feet.	11,838
19	Wiyenzele Dam	Earth dam for domestic and cattle watering, height 38′, length 1,385′, earthwork 93,000 cu. yds. capacity 920 acre feet.	26,174
20	Buigiri Dam Improvements	Construction of new concrete crest wall, and Attendant's quarter.	1,104

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	Dodoma District—contd.		
21	Manchale Water Supply	Pumped supply from borehole to provide 13,200 g.p.d.	701
22	Kinampanda Water Supply	Pumped supply from borehole to provide 36,000 g.p.d.	817
23	Kelema Water Supply	Pumped supply from borehole to provide 17,400 g.p.d.	286
24	Igandu Water Supply	Pumped supply from borehole to provide 49,300 g.p.d.	984
	Singida District:		
25	Itamuka Dam Repairs	Protective grass mat placed on u/s slope to resist erosion pending permanent repairs.	1,703
26	Puma Dam Repairs	R.C. key wall constructed, and additional spillway, in this small dam across bridge in an old railway embankment.	1,068
	Iramba District:		
27	Ndago Water Supply	Pumped supply from borehole.	1,421
28	Kikongi Water Supply	Pumped supply from borehole.	689
29	Kiomboi Water Supply	Pumped supply from borehole to provide 72,000 g.p.d. to 10,000 gallon storage tank (and Minor Settlement) 9,200′ of 3″ rising main.	11,680
	Kongwa District:		
30	Dossi-Dossi Water Supply	Pumped supply from borehole to provide 39,600 g.p.d. to 4,300 gallon storage tank.	1,401
	WESTERN REGION		
	Nzega District:		
31	Malolo Dam	Earth dam for domestic and cattle watering. Height 21′, length 1,270′ earthworks 48,000 cu. yds. capacity 580 acre feet.	2,285
		Construction of two 5,000 gallon circular cattle troughs.	1,872
	Kahama District:		
32	Ifufumo Dam	Renovation of existing pipe line and construction of new cattle trough.	621
	Tabora District:		
33	Igombe Dam	Levelling and repairs to spillway by direct labour, and extension of existing concrete overfall weirs from 100′ to 240′ by contract.	53,485
		Extension and improvement to outlet works.	3,790
	LAKE REGION		
	Geita District:		
34	Igalula Dam	Earth dam, 25,000 cu.yds. 1,550 ft. long, 15′ high, impounding 123 acre feet for domestic and stock use.	5,970
35	Kitongo Dam	Earth dam 20,000 cu.yds., 1,155 ft. long, 18′ high, impounding 40 acre feet for domestic and stock use.	6,307
36	Kamena Charco	Excavation 5,570 cu.yds. capacity 8 acre feet, incorporating a well. For domestic and stock use.	1,289
37	Mwingiro Charco	Excavation 5,570 cu.yds. capacity 8 acre feet, incorporating a well. For domestic and stock use.	1,252

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	Geita District—contd.		
38	Chigolwe Dam	L.B. spillway breach repaired and R.B. spillway reinstated. Earthworks 8,000 cu.yds. rock removal 400 cu. yds. masonry 200 cu. yds.	3,815
39	Mugando Dam	Syphon installed to assist flood discharge.	302
40	Geita Dam	Earthwork repairs to spiilway on behalf of P.W.D. 3,000 cu.yds.	624
41	Katunguru Water Supply	Pumped supply from Lake Victoria, to provide 13,000 gallons per day 6,400 gallon storage tank and 8,310 ft of 3″ to ½″ piping.	7,564
42	Kamuhanga Dam	Work started on earth dam 37,800 cu.yds. 2,060 ft. long, 25′ high, impounding 418 acre feet of water for domestic and stock use.	2,162
	Musoma District:		
43	Rwamkoma Dam	Earth dam, 35,000 cu. yds. 1,310 ft. long, 19′ high impounding 180 acre feet, for domestic and stock use.	6,523
44	Musoma Township Drainage Channel	18″ concrete culvert 930 ft. long, in trench up to 17 ft. deep, to drain Kitaji area into lake Victoria Excavation and backfill 2,000 cu. yds.	3,702
45	Kirumi Ferry	Built up Ferry approaches on behalf of P.W.D.	711
	Kwimba District:		
46	Magu Water Supply	13,500 gallons per day pumped from borehole to 5,000 gallon sump tank and 9,600 gallon storage tank, 8,835 feet of 2½″ to ½″ piping.	8,451
	Mwanza District:		
47	Fela and Fulo Charcos	Each charco 5,770 cu. yds. capacity 8 acre feet, incorporating a well, for domestic and stock use.	33ȼ
48	Mbarika Irrigation Scheme	Pumped supply from Lake Victoria to deliver 223,000 gallons per day through 4,050 ft. of 6″ piping to 50 acre pilot irrigation scheme.	6,262
	Maswa District:		
49	Nhomango Dam	Temporary bund across eroded spillway to impound water in dam.	217
50	Lalago Water Supply	11,000 gallon per day pumped from well in river to two storage tanks with combined capacity of 7,200 gallons, 8,700 ft. of 2½″ to ½″ dia. piping.	6,333
	West Lake Region		
	Bukoba District:		
51	Divisional Depot	Construction of carpenter's shop, covered works bay, mason's yard and aggregate bay.	1,617
52	Rubale Pipeline	Minor improvements to intake.	17
53	Rubungo, Kamachumu and Rwamashenye Water Supplies	Installation of automatic Water Dispensers in Water Selling Kiosks.	787
	Karagwe District:		
54	Lwanyongo Borehole	Installation of Climax 9D hand pump, domestic point and cattle trough.	536
	Northern Region		
	Arusha District:		
55	Leguruki Pipeline-Kikatiti Branch	20,000 g.p.d. supply, two 10,000 gallon storage tanks, two cattle troughs, and domestic points. 23,500 feet of 2″ dia. piping.	872

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	Arusha District—contd.		
56	Leguruki Pipeline-Sakila/ Matufa Branch	95,000 g.p.d. supply to Sakila/Matufa area. Two 20,000 gallon storage tanks, four domestic points and one cattle trough, 35,350 feet of 4″—4½″ piping.	18,800
57	Mbuguni Furrow Intake	3′ dia. Armco culvert, 80 feet long, with penstock, trash grill and measuring flume. Pitched protective facing 50 feet u/s and d/s.	1,139
	Kilimanjaro District:		
58	Sholo Pipeline	Gravity pipeline, from Sholo Dam, 22,070 feet of 6″—3″ pipe, 10,000 gallon storage tank, seven domestic points and one cattle trough.	48 7
59	Hulili Pipeline	20,000 g.p.d. supply to Hulili village from Mliro pipeline, 21,300 feet of 2″×1½″ pipe, two 10,000 gallon storage tanks, five domestic points and one cattle trough.	49
60	Ukiyashi Pipeline	175,000 g.p.d. supply from dam to Uckira village, 37,354 feet of 4″—2½″ pipe, eleven domestic points, one cattle trough, three 10,000 gallon, one 20,000 gallon storage tank.	1,442
61	Londorossi Pipeline Improvements	Improvement to existing scheme 300′ of 6″ pipe, twelve air vents and miscellaneous modifications.	482
62	Lyamungu Dam	1,000 cu. yds. earth dam to supply Coffee Research Station, 8′ high, 190′ long, storing 2·86 acre feet.	767
63	Mashati Maharosha Pipeline	57,600 g.p.d. supply from Mashati P/L Phase II, 13,362 feet of 4″—2″ pipe, one 20,000 gallon storage tank and four domestic points.	4,661
64	Mlembea Ussori Pipeline	57,600 g.p.d. supply from Mlembea P/L. 14,450 ft. of 3″ and 2″ piping, and two domestic points.	4,528
65	Mlembea Olele Pipeline	57,600 g.p.d. supply from Mlembea P/L., 16,000 feet of 2½″—1½″ pipe, two 20,000 gallon storage tanks, one cattle trough and eight domestic points.	7,164
66	Marangu Dispensary Pipeline	60,000 g.p.d. supply from Lower Sengia Spring, 7,400 feet of 2½″—1″ pipe, one 20,000 gallon storage tank, and two domestic points.	3,664
67	Mkuu Mwatalene Pipeline	60,000 g.p.d. supply from Motale River, 16,800 feet of 6″—2½″ pipe, one 20,000 gallon storage tank and eight domestic points.	6,427
68	Lowati Pipeline Phases I and II	156,000 g.p.d. supply from Lowati River, 46,025 feet of 6″—3″ pipe, three 20,000 gallon storage tanks, eleven domestic points and two cattle troghs.	17,664
69	Nanjara Pipeline Phase I	30,000 g.p.d. supply from Nanjara Spring, 20,500 feet of 4″—1½″.	3,997
	Mbulu District:		
70	Rhotia Pipeline	30,000 g.p.d. supply from Manera River, 43,900 feet of 4″—1½″ pipe, five 3,000 gallon storage tanks, with domestic points and five cattle troughs.	4,298

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	NORTHERN REGION—*contd.*		
	Masailand District:		
71	Malambo Pipeline Repairs	Restoration of intake, cattle trough and goat trough, relaying part of reticulation.	382
72	Munge Pipeline Repairs	Restoration of intake, break pressure points, cattle troughs, construction of new cattle trough.	47
73	Wasso Springs Pipeline	9,000 g.p.d. stock water supply from Wasso Springs, 2,500 ft. of 1½″ pipe one 4,500 gallon storage tank combined with cattle trough.	34
74	Monduli Minor Settlement Water Supply	Major improvements to existing supply to provide 60,000 g.p.d. New intake, settling tank, dosing and mixing tank, three 20,000 gallon storage tanks, resiting of steel storage tank, 7,650 ft. of 2½″—2″ pipe.	3,515
75	Lorion Valley Water Supply	30,000 g.p.d. supply from Lobulu Springs to Lorion Valley Quarantine Area, 11,400 ft. of 3″, 2½″ and 2″ pipe, one 20,000 gallon storage tank, two cattle troughs.	4,188
	TANGA REGION		
	Tanga District:		
76	Nairobi Dam	18,000 cu. yds. earth dam for cattle watering, 26′ high, 672′ long, capacity 150 acre feet.	3,988
77	Magila Water Supply	40,000 g.p.d. gravity water supply from stream, 11,480 ft. of 2″×1½″ piping, and 20,000 gallon storage tank.	5,276
78	Pongwe Water Supply Extension	Construciton of two automatic Water Selling Kiosks.	665
	Lushoto District:		
79	Kitivo Irrigation Scheme	7,000 feet of main channel extension together with regulators, road crossings, and cross drainage structures. Capacity of channel 15 cusecs.	5,485
80	Soni Water Supply	20,000 g.p.d. gravity supply from spring for domestic water, 7,100 feet of 3″ and 2″ pipe, 20,000 gallon storage tank, three water selling kiosks and twenty-four metered connections.	968
81	Mlalo Water Supply	20,000 g.p.h. gravity water supply for domestic water, 8,000 ft. of 2″ and 1½″ pipe, 20,000 gallon storage tanks, and seven water selling kiosks.	4,600
	Same District:		
82	Kamari Water Supply	1,200 g.p.h. pumped supply from borehole to 5,000 gallon tank, cattle trough and domestic point.	338
83	Muwanga Water Supply	1,200 g.p.d. pumped supply from borehole to 5,000 gallon tank, cattle trough and domestic point and including an extension of 300′ of 1½″ pipe.	1,431
84	Ndea Water Supply	Pumped supply from borehole to 5,000 gallon tank, cattle trough and domestic point.	1,715
85	Kalimawe Irrigation Scheme	6 storm water overcrossings, and 6 miles of storm water drain and bund.	12,965

SUMMARY OF WATER SUPPLY WORKS CARRIED OUT IN 1962

Location No. Map. I.	Name and Location	General Description	Exp. during year
	TANGA REGION—*contd.*		
	Handeni District:		
86	Shallow Wells	Three shallow wells constructed.	780
	Pangani District:		
87	Pangani Water Supply Phase I	Pumped supply to Minor Settlement from borehole yielding 7,000 g.p.h., 20,000 gallon storage tank, 11,000 feet of 4″ pipe. Electric submersible pump installation.	12,761
88	Boza School Water Supply	Pumped supply from borehole to 10,000 gallon storage tank.	1,645
89	Magila Water Supply Extension	Construction of additional kiosks.	595
90	Repairs to Toloha Pipeline	Relaying pipeline and repairing cattle trough as result of damage by elephants.	230
	SOUTHERN REGION	NIL.	
	SOUTHERN HIGHLANDS REGION		
	Mbeya District:		
91	Mbozi Spring Capping	Continuation of work on improvement to springs.	185
92	Mbarali Irrigation Scheme	Road syphon constructed at end of canal $SIIa_2$, and footbridge across main canal. Work by T.A.C.	—
93	Utengule Furrow	Construction of new main channel and repairs to headworks.	5,875
	Iringa District:		
94	Kalenga Irrigation Scheme	830 ft. of main channel was culverted and a 2′ dia. under syphon installed at Mbuga crossing. Length of syphon 90′.	4,563
	Njombe District:		
95	Saja and Ngani Wells	Construction of 4′ dia. concrete lined wells.	21
	Chunya District:		
96	Kanbikatoto Wells	Construction of 4′ dia. concrete lined wells.	16

DRILLING OPERATIONS, 1962

(TDS=Total Dissolved Solids, F=Fluorine, Cl=Chlorine, NO_3=Nitrates, SO_4=Sulphate)

B. H. Number and Location No. Map II	Date Completed	Depth in feet	Yield per hour in gallons	Static Water Level in feet	Dept at which water struck in feet	Chemical Properties in Parts in Million	Total Cost Shs.	Applicant	Locality and Region	Formation	Remarks
2/61 (1)	1.2.62	450	12	420	168	—	11,931	Tanganyika Agricultural Corporation	Kitengule Plains, West Lake	Clayey Alluvium, phyllites and shales of Karagwe-Ankolean	Yield insufficient abandoned.
38/61 (2)	17.1.62	232	1,400	107	125, 135 and 206	TDS. 1555.0 Cl. 696.0 F. 0.2 NO_3 trace	—	Kazamia Sisal Estate	Kunduchi, Eastern	Fine and coarse sands with angular gravel of Tertiary-deposits	—
1/62 (3)	20.3.62	168.3	Trickle only	132.6	148.6	—	11,945	Local Authority	Mtita, Dodoma, Central	Partly cemented sands and sub-angular gravels (oxidized) on contaminated Granite	Yield insufficient abandoned.
2/62 (4)	31.1.62	191	9,000	75	79.5	TDS. 960.0 Cl. 216.0 F. Nil NO_3 trace	10,663	Local Authority	Kipumbwi, Pangani Dist., Tanga	Coral limestone and sands with angular gravels of Tertiary deposits	—
3/62 (5)	15.3.62	288	60	197	230	—	8,604	Local Authority	Shume, Lushoto Dist., Tanga	Thin mantle of superficials over sericite schists and biotite-hornblende granite of Usagaran	Yield insufficient abandoned.
4/62 (6)	30.3.62	450	200	112	113	—	14,988	Tanganyika Agricultural Corporation	Kitengule Karagwe Dist., West Lake	Buff-pinkish phyllites and quarts-shales of Karagwe-Ankolean	Yield insufficient abandoned.
5/62 (7)	17.4.62	150.6	1,500	1	55	TDS. 648 Cl. 24.0 F. 4.0 NO_3 Nil	17,248	Kinampanda Lutheran Mission	Kinampanda Iramba Dist., Central	Terrestial deposits and ferricrete plus metadolerite on Nyanzian schists.	Hole gravel-screened

DRILLING OPERATIONS, 1962

(TDS=Total Dissolved Solids, F=Fluorine, Cl=Chlorine, NO_3=Nitrates, SO_4=Sulphate)

B. H. Number and Location No. Map II	Date Completed	Depth in feet	Yield per hour in gallons	Static Water Level in feet	Depth at which water struck in feet	Chemical Properties in Parts per Million	Total Cost Shs.	Applicant	Locality and Region	Formation	Remarks
6/62 (8)	11.4.62	205	3,000	18	20	TDS. 1650 Cl. 392.0 F. 0.2 NO_3 4.84	11,894	Local Authority	Mvomero, Morogoro Dist., Eastern	Clays, Sand and gravels of Quaternary deposits	Hole gravel-screened.
7/62 (9)	7.12.62	400	200	23	30 and 120	TDS. 5442.0 Cl. 718.0 F. 2.0 NO_3 Nil	17,610	Local Authority	Saga-Saga Morogoro Dist., Eastern	Clay and calcareous shales of Jurassic	Acceptance pending decision on chemical analysis results. Gravel-screened.
8/62 (10)	3.12.62 commenced	354 refilled to 300	300	173	205	Not yet received	—	Local Authority	Mkulazi Morogoro Dist., Eastern	Shales and fine grain size sandstone of Jurassic (Lower)	Drilling continue Hole gravel Hole gravel screened.
9/62 (11)	17.11.62	350	320	99.9	122	TDS. 129.0 Cl. 172.0 F. Nil NO_3 trace	21,393	Local Authority	Gronero, Morogoro Dist., Eastern	Limestone interbedded with fossiliferous sandstone of Jurassic	—
11/62 (12)	19.5.62	300	733	120	170	TDS. 408.0 Cl. 44.0 F. 0.2 NO_3 trace	15,130	Veterinary Division	Kalema, Kondoa Dist., Central	Quaternary sands and gravels on river flats over Usagaran	Hole gravel-screened.
12/62 (13)	25.5.62	152.6	562	122.6	138	TDS. 1155.0 Cl. 184.0 F. 0.4 NO_3 143.0	12,344	Local Authority	Choda, Singida Dist., Central	Mbuga limestone, iron-cemented sands on weathered hornblendes granite, followed by fresh acidic granite.	—
13/62 (14)	8.6.62	60	250	2	2	TDS. 327.0 Cl. 24.0 F. 4.8 NO_3 trace	6,940	Local Authority	Nyakato, Mwanza Dist., Lake	Quaternary completed sands in shallow river valley over pinkish granite	Hole gravel-screened and capped awaiting further surging.

DRILLING OPERATIONS, 1962

(TDS=Total Dissolved Solids, F=Fluorine, Cl=Chlorine, NO_3=Nitrates, SO_4=Sulphate)

B. H. Number and Location No. Map II	Date Completed	Depth in feet	Yield per hour in gallons	Static Water Level in feet	Depth at which water struck in feet	Chemical Properties in Parts per Million	Total Cost Shs.	Applicant	Locality and Region	Formation	Remarks
14/62 (15)	27.6.62	532	2,200+	151	202 trickle 233 246	TDS. 764.0 Cl. 24.0 F. 0.8 NO_3 trace	12,167	Local Authority	Bumbuta/Chungai, Kondoa Dist., Central	Calcareous cemented fine sands and poorly sorted sands with gravel to 230′ on weathered Usagaran	—
15/62 (16)	19.7.62	240	2,400	102	117	TDS. 684.0 Cl. 108.0 F. 2.0	9,000	Local Authority	Rhino Hill, Kondoa Dist., Central	Mbuga clays and limestone, calcareous cemented sands to 190′ then weathered geisses of Usagaran	—
16/62 (17)	21.7.62	300	1,320	47	74	TDS. 268.0 Cl. 68.0 F. Nil NO_3 trace	11,027	Local Authority	Kilimilile, Bukoba Dist.,	Raddish phyllites and dark shales of Karagwe-Ankolean	—
17/62 (18)	11.9.62	450	80	244	290	—	9,206	Local Authority	Mabale, Bukoba Dist., West Lake	Clayey alluvium over phyllites of Karagwe-Ankolean	Water insufficient Abandoned.
19/62 (19)	26.7.62	400	1,400	168	238 and 250	Not yet received	20,800	Local Authority	Imalaseko, Maswa Dist., Lake	Lacustrine clayey calcareous deposits over weathered granite	—
20/62 (20)	22.8.62	150	1,500	39	49	TDS. 907.0 Cl. 88.0 F. 5.0 NO_3 18.48	7,440	Bishop of Shinyanga	Sayu-Sayu Mission, Maswa Dist., Lake	Thin blanket of superficials over weathered granite	—
21/62 (21)	—	70	—	23.10	38	—	—	Government	Kidunda, Eastern	Mudstone shales and sandstones of Jurassic	*Exploratory bore holes at
22/62 (22)	—	45	dry	—	—	—	—	Government	Kidunda, Eastern	Sandstone of Jurassic	Kidunda, Eastern
23/62 (23)	—	30	—	—	—	—	—	Government	Kidunda, Eastern	Mudstone and sandstone of Jurassic	Region

*Remarks continue next page for all bore holes in Kidunda, Eastern Region.

DRILLING OPERATIONS, 1962

(TDS=Total Dissolved Solids, F=Fluorine, Cl=Chlorine, NO_3=Nitrates, SO_4=Sulphate)

B. H. Number and Location No. Map II	Date Completed	Depth in feet	Yield per hour in gallons	Static Water Level in feet	Depth at which water struck in feet	Chemical Properties in Parts per Million	Total Cost Shs.	Applicant	Locality and Region	Formation	Remarks
24/62 (24)	—	30	dry	—	—	—	—	Government	Kidunda, Eastern	Mudstone of Jurassic	for
25/62 (25)	—	40	dry	—	—	—	—	Government	Kidunda, Eastern	Sandstone and reddish mudstone of Jurassic	proposed Dam
26/62 (26)	—	30	dry	—	—	—	—	Government	Kidunda, Eastern	Mudstone of Jurassic	across
27/62 (27)	—	35	dry	—	—	—	—	Government	Kidunda, Eastern	Alluvial deposits then mudstone of Jurassic	Ruvu River.
28/62 (28)	10.9.62	27	—	—	—	—	5,790	Bishop of Shinyanga	Mipa Mission, Lake	Two attempts, each time fresh granite at 27′	Dry abandoned.
29/62 (29)	22.11.62	214	216	10	20	—	16,880	Local Authority	Masonwa, Maswa Dist., Lake	Sandy superficials on weathered granite, over fresh granite	Water brakish, abandoned.
32/62 (30)	8.11.62	103	1,000+	14	44 and 75	Not yet received	8,587	Local Authority	Inkumba, Iramba Dist., Central	Iron-cemented sands and gravels throughout (only partly pierced) over granite rocks	—
33/62 (31)	14.12.62	200	1,650	101	154	Not yet received	11,429	Local Authority	Tunda, Iramba Dist., Central	Calcareous clays and calcareous cemented sands and gravels over weathered and fresh granite	—
34/62 (32)	25.1.63	250	1,500	90	90	Not yet received	—	Local Authority	Zagayu, Maswa, Dist., Lake	Strata samples not yet received	—
35/62 (33)	commenced 17.12.62	67 on 31.12.62	—	—	—	—	—	Local Authority	Singa, Iramba,	Not yet received	Drilling continues.

DETAILS OF SOME SELECTED GAUGING STATIONS

(E)=Estimated without measurement, (RR)=Stations re-rated since last Annual Report,
(M)=Million, (SG)=Staff Gauge, (RG)=Rain Gauge.

Station No.	Type of Gauge	River	Catchment Area Square Miles	Position on River		Date readings started	Recorded flow to Date		Hydro-Years Nov. 1st–Oct. 30th	
				Latitude South	Longitude East		Minimum in Cusecs	Maximum in Cusecs	Mean Annual Acre-Feet	No. Years
EASTERN REGION										
1 G 1	S.G. 0-20 ft.	Wami	11,000	6° 27′	37° 32′	14.11.53	35.0	10,250	375,303	3
1 G 6	S.G. 0-25 ft.	Kisangata	79	6° 36′	37° 11′	23.7.58	1.3	1,128	32,990	2
1 G 9	S.G. 0-15 ft.	Mkundi	703	6° 15′	37° 19′	13.11.58	2.0	11,500	—	–
Resited	S.G. 0-15 ft.	Mkundi	703	6° 15′	37° 19′	18.7.62	—	(E)	—	–
1 GB 1	S.G. 0-15 ft.	Diwale	1,270	6° 10′	37° 37′	27.8.53	8.0	2,450	141,840	7
1 GB 3	Cipolletti Weir 0-1 ft. S.G. 0-5 ft.	Chazi	—	6° 12′	37° 34′	9.8.54	0.13	115	3,820	5
1 GD 2	S.G. 0-15 ft.	Mkondoa	6,780	6° 48′	36° 59′	13.3.52	45.0	3,400 (E)	200,704	7
1 GD 5	S.G. 0-15 ft.	Mkombola	104	6° 31′	36° 50′	13.9.52	18.0	1,650 (E)	47,351	8
1 GD 6	S.G. 0-15 ft.	Myombo	117	7° 04′	36° 53′	10.7.54	21.0	1,700 (E)	74,280	2
1 H 3	S.G. 0-25 ft. Cableway ...	Ruvu	2,616	7° 16′	38° 15′	26.7.51	46.0	14,000(E)	1·20(M)	9
1 H 5	S.G. 0-20 ft. Recorder ...	Ruvu	162	7° 01′	37° 48′	8.10.52	52.0	23,500(E)	397,150	8
1 H 8	S.G. 0-25 ft. Recorder ...	Ruvu	5,601	6° 41′	38° 41′	11.12.58	48.0	20,000(E)	1·08(M)	2
1 HA 1	S.G. 0-20 ft.	Ngerengere	1,096	7° 01′	38° 19′	22.8.50	Dry	2,546	91,776	11
1 HA 3	S.G. 0-15 ft. Cableway ...	Ngerengere	270	6° 44′	37° 47′	23.8.50	Dry	1,570	77,344	10
1 HA 8	Cipolletti Weir 0-1·5 ft. S.G. 0-5 ft.	Morogoro	9	6° 50′	37° 40′	27.3.54	Trace	776(RR)	13,524	5
1 HA 9	Cipolletti Weir 0-1·5 ft. S.G. 0-10 ft.	Ngerengere	8	6° 55′	37° 36′	25.3.54	2·9	2,183(E)	18,128	5
1 HA 10	S.G. 0-10 ft. Compound V-notch.	Ngera	6	6° 56′	37° 35′	21.3.54	0·13	495(E)	5,938	5
1 HB 1	River changed course into an old stream bed ...	Mgeta								
1 HB 4	Cipolletti Weir 0-1·2 ft. S.G. 0-5 ft.	Mwarazi	2	7° 00′	37° 36′	12.8.54	1·86	600(E)	5,138	7
1 HC 2	S.G. 0-25 ft. Cableway ...	Mvuha	97	7° 12′	37° 50′	11.3.54	32·0	12,000(E)	266,164	5
1 K 3	S.G. 0-40 ft. Recorder, Cableway	Rufiji	61,106	7° 48′	37° 55′	19.10.54	—	252,000(E)	20·46(M)	6
1 KA 3	S.G. 0-20 ft.	Gr. Ruaha	30,905	7° 42′	37° 00′	28.10.54	398	36,000	3·45(M)	5
1 KB 4	S.G. 0-15 ft.	Kilombero	7,048	8° 58′	35° 50′	2.1.55	2,400	29,000	5·49(M)	5
1 KB 8	S.G. 0-15 ft.	Mpanga	937	8° 55′	35° 43′	10.12.56	435	5,800	822,000	3
1 KB 9	Slope Gauge	Mnyera	1,950	9° 01′	35° 19′	8.12.56	758	14,000	1·53(M)	3
1 KB 10	S.G. 0-20 ft.	Ruhuji	3,294	8° 57′	35° 59′	12.12.56	822	15,000	2·53(M)	3

DETAILS OF SOME SELECTED GAUGING STATIONS

(E)=Estimated without measurement, (RR)=Stations re-rated since last Annual Report,
(M)=Million, (SG)=Staff Gauge, (RG)=Rain Gauge.

Station No.	Type of Gauge	River	Catchment Area Square Miles	Position on River		Date readings started	Recorded flow to Date		Hydro-Years Nov. 1st–Oct. 30th	
				Latitude South	Longitude East		Minimum in Cusecs	Maximum in Cusecs	Mean Annual Acre-Feet	No. Years
SOUTHERN HIGHLANDS REGION										
1 KB 14	S.G. 0-20 ft.	Lumemo	164	8° 08′	36° 40′	1.12.57	70	8,250(E)	211,000	2
1 KB 15	S.G. 0-20 ft.	Mgeta	124	8° 20′	36° 07′	20.11.57	127	—	—	–
1 KB 16	S.G. 0-15 ft.	Furua	507	8° 56′	36° 05′	25.11.57	80·0	8,500	482,000	2
1 KB 17	S.G. 0-25 ft. Recorders, Cableway	Kilombero	12,915	8° 12′	37° 00′	27.11.57	2,860	100,000(E)	9·0(M)	2
1 KA 2	S.G. 0-15 ft.	Little Ruaha ...	1,127	7° 47′	35° 41′	9.11.54	124	5,200	464,000	5
	Washed out and not for publication	Gt. Ruaha								
1 KA 9	S.G. Recorder R.G. not for publication	Kimani	173	8° 50′	34° 10′	1.11.54	13·0	8,400	185,000	5
1 KA 22	S.G. 0-5 ft.	Mtitu	172	8° 02′	35° 46′	10.9.56	40·0	900	84,500	2
1 KA 31	S.G. 0-10 ft.	Little Ruaha	2,005	7° 30′	35° 30′	1.11.56	79·0	5,800	473,000	3
1 KA 42	S.G. 0-15 ft.	Kisigo	9,476	6° 57′	35° 35′	15.11.57	Dry	9,500	276,000	2
1 RC 1	S.G. 0-20 ft. Slope ...	Lufirio	549	9° 29′	33° 54′	28.5.54	230	15,000	1·22(M)	
1 RC 2	S.G. 0-28·7 ft. Slope ...	Kiwira	641	9° 38′	33° 52′	20.8.54	286	20,400	1·25(M)	4
1 RC 3	Now 1 RC 3A not yet rated	Mbaka...								
1 RC 8	S.G. 0-15 ft.	Kiwira	253	9° 16′	33° 33′	6.4.57	232	10,800(E)	361,900	2
3 A 2	S.G. 0-10 ft.	Songwe	187·5	8° 59′	33° 13′	12.10.55	14·2	2,650(E)	105,275	4
3 A 6	S.G. 0-5 ft.	Nzovwe	44·5	8° 56′	33° 25′	9.9.55	15·0	200	26,967	4
3 A 7	S.G. 0-5 ft.	Ruanda	18·7	8° 58′	33° 06′	30.9.55	0·25	446	14,380	3
3 A 8	S.G. 0-10 ft.	Myovisi	58·2	8° 59′	33° 04′	30.9.55	5·8	650(E)	51,876	3
3 A 12	S.G. 0-3 ft. Cipolletti Weir 0-2 ft.	Sisimba	6·36	8° 53′	33° 26′	1.9.56	0·43	45	3,403	3
3 B 10	S.G. 5-10 ft.	Hanseketwa	2·9	9° 09′	32° 53′	1.9.56	Trace	22(RR)	—	–
3 E 1	S.G. 0-10 ft.	Luika	—	8° 24′	32° 55′	23.2.57	Dry	15,000(E)	—	–
TANGA REGION										
1 B 3	S.G. 0-10 ft.	Umba	74	4° 31′ 50″	38° 22′ 15″	19,7.58	2·00	271	—	–
1 C 1	S.G. 0-12 ft.	Sigi	250	5° 00′ 55″	38° 47′ 40″	1.5.57	5·03	3,130(E)	—	–
1 D 2	S.G. 0-15 ft.	Pangani	9,650	5° 08′	38° 23′	10.7.51	398	3,600	598,000	6
1 D 3	S.G. 0-10 ft.	Pangani	7,000	4° 58′	38° 05′	12.3.52	387	1,680	406,000	2
1 D 5	S.G. 0-5 ft.	Mnyusi	265	5° 19′ 40″	38° 19′ 15″	13.2.59	Dry	1,530(E)	—	–
1 D 10	S.G. 0-10 ft.	Pangani	6,600	4° 39′	38° 02′	15.4.58	433	1,940	395,000	2
1 D 11	S.G. 0-10 ft.	Pangani	10,600	5° 17′ 45″	38° 36′ 15″	7.5.58	386	9,970(E)	534,000	2
1 D 12	S.G. 0-10 ft.	Pangani	5,860	4° 36′	37° 48′	14,2.59	328	2,240	—	–

DETAILS OF SOME SELECTED GAUGING STATIONS

(E)=Estimated without measurement, (RR)=Stations re-rated since last Annual Report,
(M)=Million, (SG)=Staff Gauge, (RG)=Rain Gauge.

Station No.	Type of Gauge	River	Catchment Area Square Miles	Position on River		Date readings started	Recorded flow to Date		Hydro-Years Nov. 1st–Oct. 30th	
				Latitude South	Longitude East		Minimum in Cusecs	Maximum in Cusecs	Mean Annual Acre-Feet	No. Years
TANGA REGION—*contd.*										
1 D 14	S.G. 0-10 ft.	Pangani	9,800	5° 10′ 08″	38° 28′ 05″	23.4.59	375(E)	6,000(E)	519,000	2
1 D 15	S.G. 0-10 ft.	Pangani	9,212	5° 03′ 45″	38° 07′ 30″	3.11.59	435	2,560	519,000	2
1 DB 6	S.G. 0-10 ft.	Mombo	180	4° 53′ 20″	38° 15′ 17″	15.1.53	3·32	520(E)	—	–
NORTHERN REGION										
1 D 8	S.G. 0-10 ft.	Pangani	2,900	3° 48′	37° 28′	1.7.57	498	7,000(E)	678,000	3
1 DC 1	S.G. 0-10 ft.	Ruvu	1,000	3° 33′	37° 29′	19.8.52	200	1,350	348,000	3
1 DC 2A	S.G. 0-10 ft.	Ruvu	570(E)	3° 31′ 40″	37° 33′ 50″	27.11.59	80·0	610(E)	—	–
1 DC 3A	S.G. 0-5 ft.	Rau	150(E)	3° 30′	37° 27′	23.9.60	1·80	350	—	–
1 DC 6	S.G. 0-10 ft.	Muo	64	3° 29′	37° 28′	17.6.52	111	796(E)	106,000	4
1 DC 7	S.G. 0-10 ft.	Muo	28	3° 25′	37° 31′	28.12.53	Dry	350(E)	—	–
1 DC 11	S.G. 0-5 ft.	Himo	63	3° 33′	37° 33′	30.9.59	Dry	2,870(E)	63,200	3
1 DC 13	S.G. 0-5 ft.	Njoro tatu	—	3° 25′	37° 41′	25.8.52	5·0	51(E)	—	–
1 DC 15A	S.G. 0-5 ft.	Taveta canal	—	3° 41′	37° 48′	1.6.54	Dry	92(E)	17,700	6
1 DD 1	S.G. 0-15 ft. and recorder	Kikuletwa	1,123	3° 31′ 30″	37° 25′ 20″	1.5.52	298	11,600(E)	539,000	5
1 DD 2	S.G. 0-10 ft. and recorder	Kikuletwa	980	3° 30′	37° 17′	3.3.52	336	2,470(E)	325,000	3
1 DD 3	S.G. 5-20 ft.	Karanga	78	3° 18′	37° 18′	1.2.53	1·71	2,240	72,200	6
1 DD 5A	S.G. 0-5 ft.	Weruweru	61	3° 20′	37° 10′	12.11.57	Dry	721(E)	20,700	2
1 DD 7	S.G. 10-15 ft.	Nsere	21	3° 19′	37° 15′	11.2.53	0·7	643(E)	12,300	3
1 DD 8	S.G. 10-15 ft.	Kikafu	53	3° 19′	37° 13′	1.12.52	2·0	11,600(E)	148,000	5
1 DD 9	S.G. 10-20 ft.	Kware	35	3° 20′	37° 10′	11.11.52	Dry	561(E)	8,860	6
1 DD 10	S.G. 0-10 ft.	Kware	16	3° 17′	37° 09′	24.2.53	0·24	658(E)	10,600	6
1 DD 38	S.G. 0-5 ft.	Geraragua	11	3° 04′	37° 04′	3.4.53	Dry	1,150(E)	8,520	4
2 C 7	S.G. 10-20 ft.	Ngare Nairobi S. ...	15	3° 02′	37° 03′	25.2.54	Trace	920(E)	7,020	2
CENTRAL REGION										
1 GD 16	S.G. 0-15 ft.	Kinyasungwe ...	4,140	6° 12′	36° 17′	26.2.58	Dry	2,180(E)	—	–
2 R 1A	S.G. 0-20 ft.	Bubu	2,694	5° 18′ 50″	35° 35′	Nov. 59	Dry	497	—	–
2 R 4	S.G. 0-10 ft.	Bubu	3,969	5° 57′	35° 18′	25.9.59	Dry	1,330	—	–
2 R 5	S.G. 0-10 ft.	Bubu	1,084	4° 49′ 10″	35° 42′ 07″	3.3.56	Dry	784	—	–
2 R 7	S.G. 0-15 ft.	Bubu	1,613	5° 12′ 35″	35° 44′ 50″	1.12.56	Dry	871	—	–
2 R 8	S.G. 0-10 ft.	Bubu	889	4° 55′ 08″	35° 40′	13.11.59	Dry	912	—	–
2 R 15A	Four Section Reach ...	Mkondoa	96	4° 54′ 06″	35° 46′	1.12.59	Dry	14,800(E)	—	–

APPENDIX IV

DEPARTMENTAL TRANSPORT, PLANT AND EARTH-MOVING EQUIPMENT, 1962

1.	Petrol Vehicles	Bedford Pick-up	8
		Bedford 30 cwt.	7
		Bedford 2 ton.	6
		Bedford 3 ton.	8
		Bedford 5 ton.	38
		Bedford 5 ton. Tipper	21
		Bedford 5 ton Tipper L.W.B.	25
		Bedford Scammell with 8 ton Pipe Trailer	8
		Bedford 7 ton	2
		Ford Workshop	1
		Dodge Workshop	1
		Land Rover S.W.B.	23
		Land Rover L.W.B.	60
		Motor Cycle, B.S.A. 500 c.c.	1
2.	Diesel Vehicles	Thornycroft "Nubian" 5 ton	10
		Scammell Medium Duty Tractor	1
		Bedford 2 ton	10
		Leyland Comet 4×4	44
3.	Caravans	All Types	3
4.	Trailers	Low Loader 24 ton	1
		Low Loader 18 ton	1
		Low Loader 15 ton	1
		Low Loader 8 ton	6
		Water Tank 200 gallons	15
		Water Tank 800 gallons	14
		Fuel Oil Tanker 450 gallons	1
		Fuel Oil Tanker 1,500 gallons	3
		Land Rover Trailers	18
		Load Carrying 4 ton	1
		Load Carrying 5 ton	2
		Load Carrying 6 ton	3
		Pipe Trailer	1
5.	Drilling Rigs	Ruston Bucyrus 22 W	9
		Banka Drill	13
		Diamond Drill Craelius	1
		Lightweight Soil Testing Rig	1
6.	Tractors, Wheeled	Fordson Major	1
		Tournapull Model "D" Roadster	9
		Caterpillar D.W. 15	3
		Fordson Manual Roadless 4×4	1
7.	Tractors, Tracked	Carterpillar D. 2	4
		Carterpillar D. 4	21
		Carterpillar D. 7	9
		Caterpillar D. 8	1
		International T.D. 18	1
8.	Scrapers	La-Plante Choate 4 cubic yards	3
		Le-Tourneau 4 cubic yards	4
		Landsbourough/Findlay 4 cubic yards	1
		Killefer Botary	4
		Le-Tourneau, 8/11 cubic yards	5
		Bartles 4 cubic yards	3
		Caterpillar Type No. 40, 4 cu. yds.	11
		Caterpillar No. 428, 13 cu. yds.	3
		Caterpillar No. 435, 13 cu. yds.	4
		Onions 4/6	2

DEPARTMENTAL TRANSPORT, PLANT AND EARTH-MOVING EQUIPMENT, 1962

9.	Rippers	Killefer	1
		Onions	2
		Blan Knox	1
		Le-Tourneau	2
		Bartles Series 20 S.H.	3
		Caterpillar No. 4	3
		Ateco, Hydraulic Rear Mounted	3
10.	Traxcavator	Traxcavator No. 955	1
11.	Compressors	Holman 68 C.F.M.	7
		Holman 150 C.F.M.	4
		Holman 215 C.F.M.	3
		Fordson Tractor	1
12.	Rock Drills	Warsop	2
		Atlas Copco	5
13.	Concrete Mixers	Godwin 7/5	9
		Godwin 10/7	1
		Parker 5/3½	5
		Parker 7/5	1
		Parker 10/7	2
		Winget 5/3½	2
		Winget 7/5	15
		Millar 10/7	1
		Bedford 10/7	1
14.	Portable Pumps	Winget	4
		Pegson 3″	12
		Sykes	1
		Dando Diaphragm	9
		Pegson Diaphragm 4″	6
15.	Stone Crushers	Baxter	1
		Pegson	5
16.	Mobile Welding Sets	Quasi-Arc	4
17.	Excavators	Ruston-Bucyrus 10 R.B.	2
18.	Dumpers	Muirhill 5 cubic yards	3
19.	Tile Machine	Pegson	1
	Block Machine	Various	17
20.	Vibrating Pokers	Winget	6
21.	Power Mast	Locally Built	1
22.	Terracers	Preco	7
23.	Fire Pump	Coventry Climax Trailer	1
24.	Lighting Set	Brush Petter 1; 25 K.W.	1
25.	Motor Boat	B.B.S.	1
26.	Mobile Charging Plant	Alco	1

APPENDIX V

SUMMARY OF COMPLETED WATER DEVELOPMENT WORKS, 1962

Item	Description		Completed during 1962
1.	Earth dams, hafirs and charcos	No.	9
2.	Total storage capacity of item 1.	Acre-feet	1,011
3.*	Gravity pipelines and pumped supplies	No.	21
4.*	Total delivery from item 3	Gallons/Day × 1,000	1,070
5.	Boreholes successfully drilled	No.	17
6.	Total footage of item 5	Feet	3,654
7.	Total test yield of item 5	Gallons/Hour × 1,000	29

*Includes 223,000 g.p.d. supply to Mbarika Pilot Irrigation Scheme.

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